McGraw-Hill Publishing Company, Inc. APRIL 1933 Price 35c. per copy

AVIATION

The Oldest American Aeronautical Magazine

AGAIN · PRATT & WHITNEY

SETS THE PACE WITH THE

THE Twin Wasp Junior developed by Pratt & Whitney in 1932 was the first 14-cylinder two-row radial engine to be built in America. Now the Twin Wasp takes its place as the latest example of Pratt & Whitney engineering leadership. ● Like its smaller predecessor, the Twin Wasp is a 14-cylinder power plant, developed with the cooperation and assistance of the Bureau of Aeronautics, Navy Department, and of the U. S. Army Air Corps. ● With an outside diameter considerably less than that of the 9-cylinder Wasp, the new Twin Wasp offers more horsepower than has heretofore been available in any American standard production aircraft engine. At its rated R.P.M. the Twin Wasp develops 800 horsepower. Low head resistance and a high ratio of power to weight are combined with the traditional Pratt & Whitney dependability. ● Once again Pratt & Whitney leads the way in the development of 2-row radial aircraft engines.

THE SIGN OF DEPENDABILITY

Wasp* & Hornet* *Engines*

* REGISTERED TRADE-MARK

THE PRATT & WHITNEY AIRCRAFT CO. . . . EAST HARTFORD . . . CONNECTICUT

Subsidiary of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, P. Q.; in Germany by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo.

Leslie E. Neville
Managing Editor

S. Paul Johnston
Assistant Editor

Eleanor Neill
Statistical Editor

David J. Leisk
Art Director

AVIATION

Est. 1916 McGraw-Hill Publishing Company, Inc.

The Oldest American Aeronautical Magazine

Edward P. Warner, *Editor*

Louis F. Stoll, *Publishing Director*

Contents for April, 1933

Volume 32, Number 4

The equipment of air forces *By John J. Ide* 101
The eighth of a series. France (part one)

French fighters 105
Pursuit and observation

Quiet within the airplane *By Stephen J. Zand* 106
Soundproofing progress brought up to date

Maintenance on the Royal Dutch Air Lines 109
Centralized servicing for an intercontinental service

Art in air travel sales 112
A collection of posters from European Air Lines

The Dragon in flight 114
Automobile development in China

Editorials 116
The New Deal and the air mail. Behavels slips out

News of the month 118
Washington appointees. Ranger launched. Macon christened. Blind landing

Side slips 123
By Robert R. Osborn

Flying equipment 124
Boeing Transport. Aircraft Development V-1. Heinkel. P. & W. Twin Hornet Wasp. Goodyear brake

What our readers say 130
Retractable landing gears

Servicing short cuts 132
Servicing features in the Wright Condor transport

Published monthly. United States and Mexico $3.00. Canada (including Canadian duty) $3.50. Central and South America $3.00 a year. All other countries $3.00 a year, U. S. currency or 10 shillings. 35 cents a copy. Entered as second class matter July 22, 1929, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

McGraw-Hill Publishing Company, Inc., 330 West 42d St., New York, N. Y.

Cable Address "MCGRAWHILL, N. Y."

520 North Michigan Avenue
CHICAGO

Aldwych House, Aldwych
LONDON, W. C. 2

883 Mission Street
SAN FRANCISCO

James H. McGraw, Chairman of the Board
Malcolm Muir, President
James H. McGraw, Jr., Vice-President and Treasurer
Mason Britton, Vice-President
Edgar Kobak, Vice-President
H. C. Parmelee, Vice-President and Editorial Director
Harold W. McGraw, Vice-President
C. H. Thompson, Secretary

Washington, National Press Building
Philadelphia, 16 South Broad Street
Cleveland, 501 Guardian Building
Detroit, 2-257 General Motors Building
St. Louis, 1556 Bell Telephone Building
Boston, 1427 Statler Building
Greenville, S. C., 1301 Woodside Building

GUS and OLE . . . . . . the STANAVO BOYS

"Aw! . . . it's the same the world over!"

STANAVO

AVIATION GASOLINE
AVIATION ENGINE OIL
ROCKER ARM GREASE

STANAVO SPECIFICATION BOARD, Inc. 225 Bush St., San Francisco 910 So. Michigan Ave., Chicago 26 Broadway, N.Y.C.

The New
CURTISS·WRIGHT CONDOR

A NEW STANDARD
of Comfortable, Quiet, Economical High-speed Transportation

The new Curtiss-Wright Condors, recently placed in service on Eastern Air Transport and American Airways, are an advanced type of high-speed transport. Their payload normally consists of 3200 lbs. —15 passengers, 450 lbs. of baggage and 200 lbs. of mail. The planes have a cruising speed of 150 m.p.h., a high speed of 170 m.p.h. and a landing speed of 49 m.p.h. They are powered by two 700 H. P. Wright Cyclones, and can fly and climb on one engine.

Passenger comfort and convenience have been achieved to a remarkable degree. The cabin is as quiet as a Pullman—the result of a year's research by the acoustic engineers of the Sperry Gyroscope Company. The passenger aisle is exceptionally wide, and the cabin high enough so that it is not necessary to stoop while walking through the aisle. The chairs are upholstered for maximum passenger comfort and are arranged to permit easy conversation among passengers. Large windows provide unobstructed vision.

Curtiss-Wright designed this plane for the specific purpose of giving air transport operators a multi-engine ship having as high a cruising speed as is consistent with a safe landing speed. From the standpoint of economy, the new Condor has the lowest operating cost, per seat-mile, of any multi-engine transport now in service operation.

CURTISS—WRIGHT AIRPLANE CO.
ROBERTSON, MISSOURI
A DIVISION OF CURTISS-WRIGHT CORPORATION

AVIATION
FOR APRIL 1933

The equipment of air forces

FRANCE (PART ONE): PURSUIT AND OBSERVATION

By John Jay Ide

IT IS a fascinating task to retrace the history of the development of the materiel utilized in French service aviation since the Armistice

However, this is by no means a simple task, if only on account of the vast numbers of prototypes which have appeared during the past fourteen years The natural inventive genius of the French has found full play in producing original designs The result has been that, in the case of the pursuit class alone, one may readily compile a list of over 50 different types produced since the Armistice, excluding all variations on the same theme such as alternative power plants, and more modifications of the original model

It must be realized of course, that during the same period the actual number of different pursuit types *which have gone into quantity production* has not exceeded a dozen and it is with these that we are chiefly concerned here.

How planes are bought

The system employed in France with regard to procurement practice is intended to encourage the creation of new types and has inevitably resulted in the organization of a number of small factories with inadequate resources alongside powerful industrial organizations Whereas in England several firms have built military airplanes as "private ventures" without having received orders from the Air Ministry [see Major Stewart's article in AVIATION for December], this bold method is virtually unknown in France.

In France the land and sea components of the Air Force supply the unified Technical Service with the performances and general tactical requirements necessary for their materiel The Technical Service draws up general programs for aircraft designed to satisfy the conditions imposed by the utilizing services These programs are distributed *broadcast* to all aircraft builders who might be interested

Each constructor establishes a preliminary "dossier" which is submitted to the Stress Section of the Technical Service and later to the Commission of Examination of Designs of New Aircraft, the president of which is M Caquot, the general technical director of the Air Ministry The constructor accompanied by his engineers to defend the design appears before this commission which may accept the design as capable of realization, may defer action pending the submission of additional drawings, or may definitely reject it.

In the event that the design is accepted, the prototype, after negotiations as to price, is ordered by the Central Contract Commission, which has on its board representatives both of the Technical and of the Production Services

A complex testing system

After the contract has been signed the Technical Service controls the construction of the prototype through the inspector of the Production Service assigned to the plant The prototype completed, it is tested by the Flight Section of the Technical Service at Villacoublay (just outside of Paris) and judged by two commissions The first is the Commission for the Admissibility of Prototype Aircraft, which passes upon the results obtained by the Flight Section as to the exact performances, qualities of stability, maneuverability, etc In case tests reveal inadequate performances or some pronounced defect the machine is relegated to the museum or assigned to the testing of equipment or other work.

In the event that the airplane fulfills its tests satisfactorily, it is judged by the Commission for the Acceptance of Prototype Aircraft, which studies the performances of the machine and gives it a numerical value so that it may be considered in relation to the other entrants in the competition

The tests are not yet over, as, before it is placed in production, the airplane must pass the commission formed of members of the utilizing service, entitled "Group of New Airplanes," which has its headquarters at Villacoublay but distinct from the Flight Section of the Technical Service

The various steps outlined above for landplanes apply as well to seaplanes, except that in the latter class the various tests are conducted at St Raphaël instead of at Villacoublay

If the aircraft is accepted for produc-

tion, the General Contract Commission draws up the contract and the Commission for Production Control checks up on the agreement of the aircraft, as they are built, with the designs and drawings submitted with the contracts

It will be seen that the multiplicity of commissions does not tend to reduce the time necessary for prototype aircraft to pass into production. Moreover, whereas in England generally not more than four new types are ordered for a competition, no such limitation exists in France due to the famous "Policy of Prototypes" followed by the Technical Service since the formation of the Air Ministry at the end of 1928

Paying for experimental ships

The judges on the various commissions are frequently confronted with an embarrassment of riches. For instance, in the competition for new pursuit airplanes, now under way at Villacoublay, a dozen prototypes have been presented, all built at government expense

The contracts for prototype aircraft have the following characteristics

(1) The government pays for the expenses actually incurred during the construction

(2) The government assumes the principal risks If the aircraft fulfills the required performances the constructor retains the right of licensing its production. On the other hand, if the required performances are not reached the government becomes the owner of the machine unless it is completely reimbursed by the constructor for all its expenses If the aircraft is satisfactory the constructor is paid for the expenses during the tests, and likewise receives a special grant. If the performances exceed those required an additional bonus is received, and further bonuses are paid in the unlikely event of early delivery

(3) On acount of its assistance and the risk which it assumes, the state acquires under the contract the right to build the aircraft in any factory of its choice provided that a royalty is paid to the originator of the design [Thus the French Government, like the British, makes an explicit recognition of design right—a thing that the American Services have very seldom been in a position to do—Ed]

Pursuit plane development

At the time of the Armistice, there were under test several new fighters. Beginning with 1919, the Nieuport 29, Blériot-Spad 20 (both airplanes with Hispano Suiza 300 hp engines) and Gourdou-Leseurre monoplane (180 hp Hispano Suiza), were placed in production The model constructed in the greatest quantities was the Nieuport, a two-bay biplane with wood monocoque fuselage which proved so popular that it was made by Bleriot, Potez, Levasseur, Letord, Schreck, Farman, and Buscaylet, in addition to the parent firm

In 1922 the Dewoitine I and Bernard 1 monoplanes and in 1923 the Bleriot-Spad 81 biplane were brought out, all having the Hispano Suiza 300 hp engine Orders were given to S E C M for 44 Dewoitines and to Bleriot for 80 Spads

Up to 1922, pursuit airplane construction was either entirely of wood or of wood and duralumin However, the Dewoitine created a precedent by being entirely of duralumin except for the fabric wing and tail covering

Characteristics of New French Long-Distance Observation Airplanes

(All with 650 hp water-cooled engines)

	Wing area (sq ft.)	Weight empty (lb.)	Useful load (lb.)	Total weight (lb)	Wing loading (lb./sq ft.)	Speed at 16 400 ft. (m.p.h.)	Climb to 16 400 ft. (minutes)
Breguet 33	513	4 114	1 526	5 640	11.0	155	19 0
Latecoere 491	280	3 435	1 834	5,269	18 8	171	14 5
Mureaux 111	376	3 263	1 940	5 203	13.8	168	14 0
Nieuport 580	409	3 616	1 896	5 512	13 5	162	17 0
Potez 37	376	3 470	2,037	5 507	14 7	160	17 0

Higher-powered pursuit

In 1925 it was finally appreciated that 300 hp power units were no longer adequate for pursuit machines As there existed at this time air and water-cooled engines of between 400 and 500 hp light enough for installation in single-seaters, a program was drawn up for a pursuit airplane competition which took place in the summer of 1925

Following the presentation of various types in this competition, production orders were given for the Nieuport-Delage 42 sesquiplane (500 hp Hispano Suiza) as well as for the Gourdon-Leseurre 32 and Wibault 7 monoplanes (each with 420 hp Gnome-Rhone "Jupiter" engine)

The first two were of mixed wood and duralumin construction, whereas the Wibault was entirely of duralumin, including the wing covering (the first of that kind in France)

The Nieuport 42 had barely entered into service when the examples delivered were withdrawn and replaced by a variant which had a strengthened and enlarged tail plane. Though this machine called the Type 62, has been in service since 1927, it still equips over 70 per cent of the French pursuit regiments

The fuselage is an elliptical fabric-covered shell, with from three to five strips of tulip-wood glued over two moulds for the upper and lower half-shells This was an improvement over the single mould used in the Type 29, as the mould did not have to be broken up in order to be extracted from the fuselage The two halves of the fuselage were assembled by plywood rings and by fastening together the main longerons of the shells The duralumin engine bed extends back to the rear of the cockpit and carries the seat and control levels The wings have plywood ribs and box-section duralumin spars with laminated flanges. The covering from the leading edge to the front spar is of plywood, the after portion being of fabric The small lower wing is of wood covered with fabric.

Of the three types placed in production the Nieuport has the highest speed both at ground level (168 m p h) and at 16,400 ft. (155 m p h), the speeds of the Gourdou and Wibault at 16,400 ft are only 147 and 138 m p h. respectively It takes the Nieuport and Gourdou 13 3 minutes, the Wibault 15 2 minutes, to climb to that height.

In 1928 there was a sudden but short-lived enthusiasm for the "Jockey" type of pursuit airplane, which carried only enough fuel for 1½ hours' flight In its insistence on extremely rapid climb it resembled the British "interceptor fighters" but it differed from them in other respects. The type quickly disappeared.

In 1928 a refined and metalized version of the Nieuport 62 appeared It was called the Type 72 and had a 500 hp Hispano Suiza engine. In the same year were brought out the Dewoitine D 27, Blériot-Spad 91, Wibault 130 and in 1929 the Wibault 210 and S.E C M-Amiot 110 airplanes. All had Hispano 500 hp. engines. Likewise all were monoplanes, except the Nieuport sesquiplane and the Blériot-Spad biplane The Wibault 210 set a fashion for low-wing pursuit monoplanes, later followed in this country

The Dewoitine has been adopted in Switzerland as the standard fighter of the Army Air Force A few have been built in France after being strengthened and called the D 53 The other types submitted have never been accepted, although Blériot for instance has built six variations of the 91 in an effort to make the machine conform to the program. The latest model, the 91-7, an inverted sesquiplane (upperwing clipped) holds the 500 kilometer record at a speed of 192 m.p h

The Dewoitine wing has two box spars with laminated flanges riveted to duralumin sheet webs. The ribs are of duralumin tubes, the wing covering of cloth The duralumin fuselage is a shell composed of four channel-section longerons and stringers carrying the duralumin sheet covering, the shape being maintained by rings The engine is a 500 hp Hispano The D 53, with a gross weight of 3,043 lb, makes 165 m p h at 16,400 ft, climbs to that height in 97 minutes, and shows a service ceiling of 28,000 ft.

Supercharging grows popular

The neglect of the supercharger in France, the home of its inventor, M. Rateau, is a curious phase of the history of French post-war aviation The Rateau exhaust driven supercharger was brought out in 1918. Fitted to Breguet 14 observation biplanes (300 hp Renault) it increased the speed at 16,400 ft from 108 to 116 m p h and the service ceiling from 18,000 to 25,000 ft. Two squadrons of supercharged Breguet-Renault airplanes were placed in service in 1921.

After 1922 the whole problem was dropped except by the Farman firm, which finally produced a satisfactory gear-driven two-speed supercharger in collaboration with Rateau This has been adapted experimentally to the Nieuport 62 airplane in an effort to prolong its life (by increasing the speed 20 m p h. at 16,400 ft.) pending the appearance of the new group of pursuit airplanes designed to satisfy the program formulated in 1931 and built around the Hispano-Suiza geared supercharger engine, which gives 650 hp at 16,400 ft for a dry weight of 930 lb

The pursuit airplanes built to take this engine include the Dewoitine D 500 Nieuport 121, Bernard 260, Blériot 510, Morane 325 Mureaux 170, and Loire 43, so that it is hoped that the present crisis in pursuit material will be of short duration It must be realized however, that in the most favorable circumstances none of these new machines, which will be competitively tested during the present spring and summer, will be in service until 1934

The new Dewoitine D 500 low-wing monoplane has in unofficial tests more than fulfilled the requirements of 217 m p h at 16,400 ft with a landing speed of 70 m p h It climbs to 16 400 ft in seven minutes, and its service ceiling is 36,000 ft Due to the heavy equipment (including radio) demanded by the program the total weight reaches the high figure of 3,800 lb The wing loading is 20 2 lb per sq ft

Several makers are also fitting nine and fourteen-cylinder Gnome-Rhone geared air-cooled engines, supercharged to give 500 and 670 hp at 13,000 ft. Among the new types equipped with the nine-cylinder engine are the Morane 225 and Wibault 313, designed to satisfy the same program as the Hispano-engined group mentioned above The Morane is similar to the Type 224 now in production with the supercharged "Jupiter."

Among the new pursuit airplanes deserving of special mention is the Hanriot 110 pusher monoplane designed by M Biche. The pilot sits in the nose and the 650 hp supercharged Hispano drives a pusher airscrew between the two dural booms supporting the tail

From the above expose of the development of pursuit aircraft in France it will be seen that by successive phases the general evolution has been from wood biplanes through sesquiplanes of mixed construction to high and low-wing all-duralumin monoplanes

The areas have changed from 290 sq ft in the Nieuport 29 to 313 in the Nieuport 62, and now to 188 in the Dewoitine D 500 As the total weights have changed from 2,400 lb through 4,026 to 3,800, the wing loadings have increased from 8.3 through 12 8 to 20 2 lb sq ft

The power of the engines has passed from 300 to 570 at sea level, and now will reach 650 at 16,400 ft Water-cooling has been in the ascendency throughout the whole period under review, although air-cooling is used to a limited extent

At various times the French authorities have investigated the possibilities of two-seat fighters, and in 1926 a presentation of machines took place, among the makers being Avimeta, Bechereau, Mureaux, Villiers and Wibault. The last-named mounted the 500 hp Hispano Suiza With a total weight of 4,520 lb (carrying 1,850 lb useful load) the ship had a speed of 139 m.p.h at 16,400 ft and a climb of 20 3 minutes in climbing to that height Such performances were not sufficiently attractive to interest the Army, and the program was abandoned

Observation planes

The French airplane used almost exclusively for observation at the end of the War was the Breguet 14A2 biplane (300 hp Renault engine) weighing 3,858 lb and making 116 m.p.h at sea level

Notwithstanding the date of its design (1916) this airplane was built largely of duralumin it had a very long life, the last orders not being given until the end of 1924

In 1921 Henry Potez brought out his Type 15 observation biplane which although of wood was ordered in quantities until 1925 It had the 370 hp. Lorraine engine.

In 1922 there appeared the famous Breguet 19, entirely of duralumin construction except for the fabric wing covering This airplane had been fitted during the past ten years with a great variety of engines the 400 and 450 hp Lorraines, the 480, 500 and 550 hp Renaults, the 450, 500 and 600 hp. Hispano Suizas, the 500 hp Farmans, the 420 hp Gnome-Rhone "Jupiter," and the 500 hp Salmson Equipped with the 450-hp Lorraine engine, one of the standard types in the observation regiments, the Breguet 19 shows:

Wing area, sq.ft	530
Weight empty lb	2,546
Useful load, lb	1,781
Total weight lb	4 327
Speed at sea level m p.h	135
Speed at 16 400 ft , m p.h	122
Climb to 16 400 ft., minutes	21 7
Service ceiling, ft	24 000

The type was gradually refined over a period of years by changes in wing tip form, cabane structure, etc , a later variant being the 19-7 of 1930 with the 600 hp Hispano Suiza engine The 19-7, with a total weight of 5,236 lb , flew 151 m p.h at sea-level Finally, the same airplane equipped with the new Gnome-Rhone fourteen-cylinder Mistral Major in September last reached an altitude of 31,000 ft with 1,100 lb of ballast, an impressive performance indeed for a machine designed over ten years ago The speed of the Mistral-engined 19-8 at 16,400 ft. is 170 8 m p h

To revert to our historical study, at the Paris Salon held at the end of 1924 was shown the Potez 25A2 observation biplane Although of wood, it was much liked on account of its simple construction and good performance. After a long career this airplane has been given a new lease of life by fitting the supercharged Gnome-Rhone 700-hp Mistral Major Thus equipped, and baptized the Potez 50, the following extraordinary performances with a total weight of 5,070 lb have been determined:

Speed at 16 400 ft., m p.h	175
Climb to 16 400 ft., minutes	10 5
Climb to 26 240 ft , minutes	20 4

While the Breguet 19 and the Potez 25 still form the regular equipment of the observation regiments, several prototypes made their appearance in 1930. These included the Breguet 27 biplane and the Potez 39 and Bureaux 130 monoplanes, all with 500-hp. Hispano Suiza engines Production orders have been given for the Breguet and Potez

The Breguet 27 has attracted intense interest by the novelty of its design. The structural "backbone" consists of a riveted high-tensile-steel girder running fore and aft Another similar girder, running thwartships, forms the spar of the small lower wing and carries the landing wheels. The fuselage, merely a lightly-built duralumin structure surrounding the longitudinal girder, terminates just aft of the rear cockpit so giving the observer a good field of fire below the tail and removing the necessity for a special gun in the fuselage floor With almost exactly the same weight as the Breguet 19 7 (and 20 per cent less power) the 27 is about 2 miles an hour slower.

The Potez 39 is a monoplane with a high wing in which the two I-beam

spars are of steel and the ribs of duralumin. The wing is supported on each side by a pair of struts forming a V, the apex of which is at the lower longeron of the fuselage One of the best features of this machine is the great depth (over 5 ft) and roominess of the observer's cockpit Both the fuselage and wing are covered with ribbed duralumin sheet With an empty weight of 670 lb less than the Breguet 27, and 350 lb more useful load, the performance is fractionally better in most respects

Long-distance observation

The above machines (as equipped for observation) are designed for use as "Corps d'Armee" types (equivalent to Corps Observation in our Army Air Corps) and by the program must have a range of 560 miles at 140 m p h at 11 500 ft carrying at least 72 gal of fuel

The useful load may be increased by 1,100 lb to allow the machines to be used as light bombers carrying two bombs of 440 lb and ten of 22 lb

The above machines do not solve the problem of long-distance strategic reconnaissance, and the solution of converting the Breguet 19 into a three seater (Type 23) not appealing to the authorities, a competition has been taking place ever since the summer of 1931 (with no final decision as yet) for two-seated observation airplanes combining good performance long range, fighting qualities, and complete equipment Seven competitors entered the trials all equipped with the 650 hp direct drive Hispano-Suiza engine: the Breguet 33, a slightly enlarged version of the Type 27, Latecoere 49, Mureaux 111, Nieuport 580, Potez 37 S.E.C.M 130 (later withdrawn) and Weymann 80 Except for the Weymann, all the competitors are not only built of metal but have duralumin wing covering (the Weymann having a welded-steel-tube fuselage and fabric covering) With the exception of the Weymann biplane and the Breguet sesquiplane, they are all high-wing monoplanes As Weymann is now inactive, its entry may be disregarded

In view of the fairly high speeds, special attempts have been made to protect the rear gunner from the wind blast. Several different methods are under experiment In the Latecoere there is a telescopic windshield divided into sections and sliding horizontally over the cockpits In the Mureaux, a small windshield is used in connection with an adjustable flap on the wing which deflects the air stream over the gunner's head. In the Nieuport the gunner has a windshield which is partially collapsible, being composed of three overlapping sections. The Breguet uses a fixed vertical windshield with side panels, as in the Type 27

The increased area of fire from the rear cockpit characteristic of the Breguet has been attained in the Potez by similar means, a conical duralumin boom carrying the tail being bolted to the main portion of the fuselage To facilitate inspection and repair, each wing of the Potez is composed of five separate parts assembled by external steel angles The interior of the wing may readily be examined by quickly removable panels in the lower surface

The Mureaux 111 is considered a likely winner of the competition, and the firm has received a small production order Although its speed at sea-level is slightly lower than that of the Latecoere 491, its characteristics at the working altitude of 16,400 ft are more satisfactory, due to its greater wing surface (376 as against 280 sq ft). The two spars of the Mureaux are lightened I-beams interconnected by Warren girder cross-pieces, forming boxes instead of the usual ribs The smooth wing covering is riveted to the spars and to several channel sections running parallel with them. The leading edge is detachable

The fuselage is composed of angle-section longerons braced by channel-section transverse frames, the whole covered with duralumin sheet The cross-section, chosen with special reference to vision downward, has proved aerodynamically good it is trapezoidal (with the smaller base below) with rounded top and bottom and flat sides

Above Negative overhang and, a faired landing gear axle are among the outstanding characteristics of the 1933 Bleriot Spad 91 7 pursuit. (600 hp Hispano Suiza)

Left A partially collapsible windshield is used to protect the gunner in the rear cockpit of the Nieuport 58? R2 long distance observation plane (600 hp Hispano Suiza)

Below Withstanding the test of time, the Nieuport 29 pursuit biplane was used extensively from 1919 to 1927 It employs the 300-hp. Hispano Suiza

Right: The tail of the Potez 37R2 long distance observation is carried on a conical duralumin boom bolted to the main portion of the fuselage providing an increased area of fire

Left: Interest was short lived in the Nieuport 48 "Jockey" type pursuit plane which carried fuel for only 1½ hours of flight. In its rapid rate of climb it resembled the British "interceptor fighters"

Right: Increased area of fire has been attained also in the Breguet 27A2 observation plane (500-hp Hispano Suiza) by outrigger attachment of the tail

Left: From 1919 to 1924 the Breguet 14A2 observation biplane (300 hp. Renault) was in use Below: The 1933 Dewoitine D 500 Pursuit has a long ancestry of metal construction The engine is the Hispano Suiza 12XBRS developing 650 hp at 10 400 ft

French fighters

PURSUIT AND OBSERVATION

Left One of the 1929 crop of high powered pursuit planes,—the Dewoitine D27 with 500-hp Hispano Suiza engine

Silence, the long sought quality of cabin comfort, is not attained by the control of any single factor in design, but can be achieved only by the careful individual elimination of each contributing cause of sound transmission from without. A single small leak may destroy the benefits derived from many hours of research, and ventilation and heating systems are frequent sources of leakage. Enviable results have been attained, however, through painstaking attention to every detail.

Quiet within the airplane

By Stephen J. Zand

Sperry Gyroscope Company

THERE are still a great number of people in the aeronautical industry who think that relatively quiet airplane cabins are either a dream or, if they become a reality, will be the result of the application of some single magical yet-to-be-discovered, sound-absorbing material. The idea that such miraculous means would be, or already had been discovered, has led many designers to use in their airplanes a variety of sound deadening materials without due regard to the known and widely published fundamentals of acoustics. They have been so busy in designing airplanes for more speed and more payload that some of them have forgotten that revenue from airplanes is obtained from transporting a human cargo which is entitled to a reasonable amount of comfort. Air travel at a noise level of a boiler factory, no matter how much time it may save, is not alluring, and a serious study of noise elimination in transport airplanes became so imperative that it was included in the 1932-1933 research program of the Sperry Gyroscope Company.

The first step in organizing any engineering problem is a determination of all available data and a program for securing the necessary additional facts. These are generally secured through some form of engineering measurements. The existence of measuring units is generally presupposed, but only recently has an attempt been made to create a unit which serves to express loudness. This unit is the bel, which is subdivided into 10 decibels. [For a detailed description and history of this unit, see "The Decibel," by the author in *Aviation Engineering*, February 1933, page 19.]

A decibel is, roughly, the measure of an increase in sound just discernible to the ear as an increase. The faintest sound which can be heard marks the threshold of hearing and may be called 1 decibel above the threshold of hearing. The range from the threshold up to a noise so loud as to be actually painful can be covered by about 120 steps, or 120 decibels. This makes possible a scale of sound levels from 0 to 120, with which the airplane designer should be familiar, as all noises may be rated approximately on this scale. The airplane noise problem starts at the very top of the scale, since the combined noise of an airplane propeller and unmuffled engine at a distance of approximately 5 ft. is about 110 to 120 decibels, and is nearly at the painful point to the unprotected ear.

Fig. 1 shows, roughly, the different noise levels in transportation and their relative influence upon the effort necessary to be able to converse.

As the decibel is the unit of measure of such an involved phenomenon as sound, let us now give some fundamentals of this unit.

1. The decibel is a *ratio* of two intensities or powers—or if P_0 is the input and P_i is the output, then $\frac{P_0}{P_i} = r^n$

$$\text{or } n = 10_{\log_{10}} \frac{P_0}{P_i} = db$$

2. The relation between actual sound energy and the loudness sensation as expressed by decibels is logarithmic.

3. An increase or decrease or approximately 25 per cent in the energy of the sound is necessary to make a sensation difference of 1 decibel.

4. A change of sound energy of 100 times is necessary to make a loudness change of only 20 decibels.

5. If an airplane engine makes a noise equal to 100 decibels, two such engines make a noise equal to only 103 decibels.

6. But if we want to reduce the noise of these two engines to a 60-decibel level in the cabin, we must reduce the sound energy in the cabin to 1/10,000 of what it is outside the cabin.

7. Whenever the *intensity* of a sound is *increased 100 per cent*, it is increased 3 decibels above its previous value. Conversely, when the *intensity* of a sound is reduced *3 decibels*, it is reduced *50 per cent*.

8. Whenever the *pressure* of a sound wave is doubled, it is increased *6 decibels*. Conversely, whenever *pressure* of a sound wave is reduced *6 decibels* it is reduced 50 per cent.

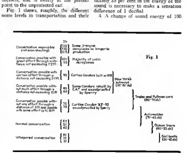


Fig. 1

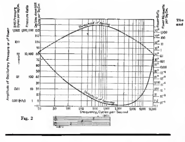


Fig. 2

The range within which the human ear works, and the relative effects of various pitches

Fig. 2 shows the range of auditory sensation for the average human ear. From this diagram may also be seen the different relations of the decibel scale to pressure or electrical power. Obviously, it must be emphasized that unless the threshold is specified, absolute expressions in decibels, being a ratio, have no significance whatsoever. For the time being, as many as, four thresholds are being used by different observers. In our work we have used $P_0 = .001$ dyne per sq cm, or 1 millibar. Corrections are easily applied for different threshold values. Referring further to Fig 2, we see that the human ear is most sensitive in the range of 2,000 cycles per second and less sensitive as we approach the lower and higher limit of audibility. The energy content of a very low or very high note must be much greater than that of a note of approximately 2,000 c.p.s. in order to create the same change of loudness sensation. The average person is also surprised at the exceedingly minute amount of energy generated by the human voice. Thus, it would require not less than 15,000,000 people speaking at once to generate only 1 horsepower of acoustical energy! Naturally, therefore, the instruments which directly measure loudness or sound energy are very delicate and hardly portable. Fortunately, we have the vacuum tube, which is ideally suited to amplify this energy in a constant and known value without distortion, so that loudness measuring instruments are now available which will withstand any amount of reasonably rough handling. The instrument which we use in our work was built by Dr. E. E. Free Laboratories, and consists of a condenser microphone, a powerful amplifier, an attenuator and a meter, which reads directly in decibels. The whole unit is portable, and with all accessories (dry A, B and C batteries) weighs about 60 lb.

As space is lacking for a more accurate account of the nature of sound-measuring technique, the reader is referred to the many excellent textbooks on acoustics which have recently appeared on the market. Let us now turn to the specific problem of aeronautical acoustics.

The following are the primary sources of noise in an airplane: (1) propeller, (2) exhaust, (3) engine clatter and gear noises, (4) structural vibration, (5) wall vibration (drumming), (6) clatter due to loose parts, such as ash trays, etc.

Items 1 to 4 originate outside the cabin proper and will thus be transmitted through the following parts: walls, ceiling, floor, windows, front and rear bulkheads, doors, ventilators, heaters, structural members. Items 1 to 3, moreover, can enter directly through cracks in doors, openings of any sort communicating directly with the outside, ill-fitting windows, etc. Thus energy, once it has reached the cabin proper, will be either partly reflected or partly absorbed by ceiling, walls, floors and chairs.

We often hear "If we could only put a good muffler on our airplane we would get a noiseless cabin." This is so utterly wrong and yet so common that we shall make an attempt to explain this clearly by means of an example.

Assume an airplane power plant giving a noise level of 112 decibels. About 35 per cent of the noise is from the unmuffled exhaust, 35 per cent from the propeller, and 30 per cent from the engine proper—valves, gears, clatter, carburetor hiss, etc. In terms of loudness, or decibels, it will be

Exhaust	108 db
Propeller	108 db
Engine	98 db
Total	112.5 db

The exhaust, being the loudest of the three noises, *masks* the others and stands out conspicuously, so it receives most of the attention and much work is put on mufflers. A good muffler will reduce the exhaust by about 10 decibels, bringing it down to 98 decibels. But the whole unit continues to roar at 108 decibels, except that now the *propeller*, being the *loudest*, is the conspicuous offender. To reduce propeller noise the tip speed must be reduced. A reduction of 100 ft. per second will give, according to Davis, as much as 10 decibels reduction in noise level. Hence, our improved silenced engine will still have

Exhaust muffled	98 db
Propeller geared three-blade	98 db
Engine	98 db
Total	105 db

From 112 decibels to 105 decibels, only 7 decibels reduction for all that effort. This is discouraging, but it proves by figures just what is being shown by experience, that the solution of quiet air travel does not lie in tak-

ing care of the engine or propeller noise, or even both, but in taking advantage of every small feature contributing to quietness

The decay of sound follows somewhat the law of the inverse square, hence, the farther the engine is from the cabin, the better Similarly, if we have the choice of placing the exhaust on the near or far side of the nacelle in a twin engine plane, it will be better to mount it on the latter The plane of the propeller should not intersect the cabin and if it is impossible to achieve this, due to aerodynamic considerations, then the minimum distance of the propeller tip from the structure should be at least 12 in or so, to avoid setting up terrific disturbances of vibratory character in the fuselage

In general, sound insulation is a function of the mass of the insulating material rather than its character Thus, a sheet of aluminum is just as good as a panel made of fiber board of the same weight per square foot The Bureau of Standards (Bulletin No 63, May 1929) after trying many different materials and finding that the mass-transmission ratio remained practically constant, then tried to build up composite panels of several materials in layers. While no exact theoretical explantation is as yet available, they found that composite panels of certain characteristics give a much higher transmission loss value than the mass transmission formula would indicate The Bureau of Standards panel No 33 (single sheet of aluminum 025 in, one 2-in. layer of "dry zero," and one 1/16-in sheet of Insulite, weight 97 lb per sq ft) had a transmission loss of 26 decibels at the lower frequencies We have substantially confirmed their theories and carried out tests on a great number of newly-developed materials We have also found that by undulating, corrugating and using cements of certain characteristics the designer can get some additional insulating values without paying for them in weight, although he may have to sacrifice some cabin space as a certain distance (say 5 in - 7 in) from outer skin to cabin is necessary The use of certain ceiba fiber material in the form of blankets has been widely advocated and this material has been used almost exclusively in America The sound insulating values of this blanket are excellent but we should not forget that sound leaks much worse than water A small crack or hole may admit as much as 99 per cent of acoustical energy; thus, extreme precaution is necessary to avoid packing and breaking down of fibers Sewing through into small divisions has also been used to prevent packing, but naturally every stitch is the potential source of a small hole We had a splendid opportunity to test our suspicion of the loss in efficiency of this material when we recently replaced and improved the sound proofing on a three-year-old ship Half of the blanket material removed after three years' service was pulverized and had sunk to the bottom, leaving the upper part of the structure uninsulated and therefore not effective as sound proofing Recently a new type of material has been put on the market which has all the good acoustical characteristics of the blanket, plus the feature of non-packing It comes in rolls of semi-compressed form in thicknesses from 3/8 in to 3/4 in and resembles blotting paper Using three 3/4-in layers of this material in undulated form on top of a certain fiber board of 1/2-in thickness and a cement, a panel was obtained giving a transmission loss at low frequencies of approximately 25 decibels and weighing about 45 lb per sq ft, as compared with panel No 33, weighing 97 lb per sq ft

If we insulate an airplane, we should not forget to apply the insulation to the floor also Heretofore, the floor has generally been forgotten, because of the structural difficulties encountered If the baggage and mail compartment is located under the floor, then special insulation may be dispensed with as the cargo has considerable mass.

In addition to sound insulation which has the purpose of keeping sound out of the cabin, attention must be paid to absorbing the sound which gets into the cabin Theoretically, if the cabin walls and ceiling are perfect sound reflectors, the noise level inside the cabin will build up to the same level as outside, irrespective of the sound insulation of the cabin wall Of course, no material is a perfect reflector but, even so, many materials are poor absorbers and would cause reverberation Hence much of the gain can be lost unless this is taken care of Panels of bakelite—so widely used because of their sanitary features—plywood or other smooth surfaces should be avoided. Curtains textiles and loose fabrics worked into the interior decoration scheme will be most effective especially above the window level The passengers themselves act as good absorbers in the lower half of the cabin Hence below the window level bakelite or other washable wall material can be used without serious detriment

Soundproofing versus ventilation

Assuming that we have applied what has been said above regarding engine location, propeller speed, insulation, reverberation, etc. let us now proceed to estimate the noise reduction in a cabin At the cabin the noise from the power plant is reduced to say, 105 decibels, the cabin walls, ceiling and floor have a transmission loss of, say, 25 decibels and the absorptive treatment in the cabin contributes another 5 decibels Thus, the net noise of the cabin should be 75 decibels (almost as low as a Pullman) If we make measurements, however, on this hypothetical airplane, we would find to our sorrow that the noise is nearer 90 decibels (subway express). In supplying fresh air, there would be openings communicating directly with the outside which would spoil all our effort. After further study of the combined acoustic and ventilation problem, we manage to make a noiseless yet efficient ventilating system We apply our findings to the heating system also, and finally go over our airplane carefully and plug every leak possible, yet again the noise level is far from the coveted 75 decibels. It is nearer 85 All those transmission loss figures were *laboratory* figures, and we did not take care in our imaginary design, of the mechanical transmission of vibration coming through the direct contact of the cabin and fuselage, power plant and structure. The more the idea *of discontinuity of surface between the vibrator and vibratee* is applied, the nearer we will approach to our theoretical noise level Thus, rubber or felt absorbers of suitable design should be used between the power plant and the structure and, at any point where the cabin structure touches the airplane structure proper, a felt or rubber insulator should be used Then, and then only, will the sound proofing material show its full worth

It may be inferred that this analysis is, as stated in the introduction, another of those dreams and also that we are trying to scare designers from attempting to sound-proof airplanes. Far from it! All we want to emphasize is that successful airplane sound-proofing is possible, provided *all* factors are given equal consideration. We have been fortunate enough to test our theories in actual practice, and hence we speak from experience We sound proofed one of Eastern Air Transport's older Condors, and by using all we knew we decreased the noise level from 95 decibels to 85. Naturally, we could not make a perfect job, because it was impossible to change the structure, position of engines, etc. When plans were formulated for the new Cyclone-powered Curtiss Condors, Model XT-32, we had the opportunity of working out the treatment from the beginning. This ship is the most quiet flying in the United States, as the average noise in the cabin is 75 decibels Due to the full-floating engine mount construction and also the full-floating cabin plus very careful attention to small details, this ship is practically non-vibrating It is probably the first ship in which it is possible to write and also to speak in normal voice It is even possible to talk the full 18-ft. length of the cabin without difficulty

It is not entirely improbable that we may yet see on a night airplane trip, the familiar sign, 'Quiet, please, for those who have retired'

Though there is little direct communication between the personnel of American and European airlines, the maintenance methods used in the two countries have developed along similar lines in many respects. They show just enough differences to be interesting, and to make it sure that the study of foreign practices will be profitable. The material for this article on the maintenance methods of K.L.M., one of the most remarkable of European operations, was personally collected by the editor of AVIATION during a recent visit to Europe. It has been supplemented by a large quantity of data furnished, and information specially prepared for use in AVIATION, by the managing director and the chief of the technical service of the company.

Maintenance on the Royal Dutch Air Lines

Centralized servicing for an intercontinental service

THREE-QUARTERS of the airline operations of Europe are centered in an area no larger than the State of Texas They show, however, no such uniformity of method as their geographical compactness might suggest Each country has its own company, and sometimes more than one, and each company has its own practices. There are international meetings upon traffic problems and upon the co-ordination of schedules, but the International Air Traffic Association lets operating questions strictly alone Maintenance practices and the like are governed largely by the individual views of the responsible personnel, but national characteristics and policies, industrial traditions, and international politics, also play a large part.

So, for example, the French disposition to centralization both in industrial and political affairs centers the organization of most French air transport and also of the French manufacturing industry around Paris That makes it possible and natural for the transport lines to draw upon the airplane and engine factories for extraordinary amounts of maintenance service The Farman line, operated by the manufacturing company of the same name, regularly sends all equipment back to the factory for periodic overhaul or for anything more than the most minor maintenance operations Though other French lines generally do their own work on the airplane structure, almost without exception they send engines to the factory from which they came whenever they need anything more than twenty hour servicing Presumably that has the advantage of keeping the manufacturer close to his product and always aware of what kind of trouble it is giving

Each country has its special traditional or political characteristics In Germany it is the absence of a military demand and the consequent apparent necessity of supporting three or four airplane factories by distributing air transport orders among them, with a tremendous variety of equipment in the hands of Deutsche Lufthansa as a result In the Netherlands, the Royal Dutch Air Line, which has one of the most interesting air transport problems in the world and which is famous for the economy of its operations, shows a special characteristic of being spread out too thinly to maintain any complete servicing organization over the whole extent of its routes

When at home, the Royal Dutch Air Line answers to the name of Koninklijke Luchtvaart Maatschappij, generally shortened to K.L.M. It dominates Dutch civil aviation. Of the 60-odd planes licensed in the Netherlands more than half belong to the transport company. Schiphol, the airport of Amsterdam and the most important civil flying field in the Netherlands, is managed by K.L.M. officials under contract between the company and the city Waalhaven, the second civil field in the country in importance, is given over largely to the K.L.M. shops

From Holland to the Indies

Once each week a Fokker airplane, with three Wasp engines, starts east from Amsterdam Ten days later, in the ordinary course of events, it comes to rest on the field at Batavia in Java, 7,000 miles away as the great circle flies considerably more by the somewhat roundabout course which political and commercial considerations impose About a week after arrival the plane starts back for Amsterdam with a fresh load of passengers and mail. Upon its return to the base at Schiphol it has flown about 160 hours Except for servicing in Batavia, it has had to get along with no mechanical attention except that which its own crew could give Each plane, with its crew and its complement of passengers and freight, has to be as self-contained as an ocean liner at sea

To get as much good as possible out of each flight, and to build up as rapidly as possible a body of experience which will guard against having the same trouble twice, each plane carries when it leaves Amsterdam a brand-new log book. Some log-books are merely pamphlets, but this one is a book in real fact, about 10 in square and 1 in thick Each member of the crew has at least one section of the volume assigned in which to keep his professional diary of the trip and at least one set of forms to fill in daily Each member has been specially trained for the special job that he fills. The mechanics, for example, have all served for at least a year in the Dutch shops of the line before being allowed to go out on one of the planes to Asia.

At the end of the round trip the log-book has become a flight history in several hundred pages Every incident of the flight has been recorded. Every detail of the functioning of plane and engines and instruments and radio has been tabulated There is a complete record of all radio messages received and sent Navigation problems, and the weather encountered, have been ex-

haustively reviewed There is even a section of the book devoted to the ground conditions on airports, for the K L M maintains no permanent representatives along the way, and the first intimation that some little-used airport in Western Asia is partially flooded may be received when the Dutch pilot arrives over it and prepares to make a landing In spite of such conditions, and of stringent limitations on expenditure, the first year of operation showed only one real mishap, and only six cases when a machine got as much as a day behind schedule

If any machine does lose a day the fact is most visible for all time on a chart that hangs in the office of the K L M's chief engineer at Schiphol. Time is plotted along a horizontal scale, and for each machine a line oscillates between Amsterdam at the top of the sheet and Batavia at the bottom A break in the main line means a departure from schedule Another chart shows by three bars, their length constantly being extended to keep them up to date, the total length of time that each machine has spent in actual service, in reserve, and in the shops Still another cumulative chart records the man-hours of mechanical labor that have been spent on each airplane, with skilled and semi-skilled labor separately calculated, and also the man-hours per flying hour The American engines, of which K.L.M. uses a large and a steadily growing number, have had to remain constantly in the spotlight of statistical comparison of their performance with that of the European types previously in the service [Mr. Spit, chief of the technical service of K L M writes "Since beginning the use of American engines we have found a large improvement in the costs of maintenance per running hour, for two reasons The time spent on maintenance is shorter, and the time of running between maintenance operations is longer" Mr. Plesman, managing director of the line, says that in 1932 they faced "the necessity of developing a still speedier machine, which must also be equipped with the same Pratt & Whitney Wasp C engines of 425 h.p. with which the F XII had obtained such brilliant results."—Ed]

Analyzing flight experience

When one of the machines on the Indian route finishes one of its round trips the crew turn in their log-book and go on leave for a few days to rest up In the meantime the book is dissected and copies of every bit of information that is in the least unusual or surprising, or likely to lead to new ideas in operating policy are made for distribution among the heads of the operating and mechanical departments Among the notations after one recent trip were "the new container for the manifest of mail-sacks is not satisfactory; there is a terrific draft on the chairs in the after end of the cabin; better provision for oil cooling is needed." Of course any individual report of that kind may be due to some unusual condition or to a defect in the particular piece of equipment, and may not call for any general change

A week after the end of the flight the crew come back from leave, and hold a conference with the department heads at which the experiences of the flight are thrashed out The pilot and navigator and mechanic and radio operator are all cross-examined and the final conclusions are mimeographed for distribution through the organization It is a very exceptional trip that does not lead to some new operating orders, some minor change in practice, or some new decision about some item of equipment used on the line

The engines are overhauled after every other trip, or after 320 hours The airplanes do about ten round trips, or 1,250 hours of flying, before they go to the shops for thorough overhaul The airplane work, together with the general servicing and all mechanical operations at Schiphol, is under the immediate direction of Mr G Spit, chief engineer of the K.L.M.

Plywood-winged planes

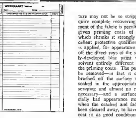
All of the engines used by K L M come from outside of Holland, and all of those regularly used on the Indian route are American. The airplanes, however, are standardized to the extent that they are all Dutch Fokkers, and all have the familiar welded-tube fuselage and plywood-covered cantilever wings. The F XIIs with which the service was started cruised at 115 m.p.h Their successors, the F XVIIIs, also Wasp-engined, cruise at 120.

Some of the planes still in regular service have done over 4,000 hours, much of it on tropical routes, and there are wings in service which have over 2,500 hours of flying without complete dismantling or rebuilding On K.L.M., as on several other European lines, there is no fixed routine of complete disassembly and stripping of the structure at the time of general overhaul The machine is inspected with great care, but it is not broken down except as inspection indicates the need Wood is never stripped from the wings except where some discoloration shows on the surface, and in order that any deterioration of the covering may be the more surely detected at the points where water would be most likely to accumulate and make trouble, the lower surface of the wing is treated only with clear varnish The upper surface is coated with aluminum paint of very special properties (only one make is considered acceptable), to give a better weather protection and also to reflect the sun's rays and reduce the temperature inside the wing The whole structure is made as nearly as possible water-tight At one time drain-holes were used in the bottom covering, but they have been abandoned It was impossible to supply enough holes to drain properly and promptly from every point of the interior, and it was found that in a really intense tropical storm the drain-holes let more water in than they ever let out

Left: A K.L.M. instrument board, for over-sea and over-jungle flying Above: Passenger capacity has been sacrificed deliberately for comfort in the Fokker F-18 used in the Amsterdam-Batavia route Six chairs with sufficient space for full length reclining, baggage space and individual folding tables are installed in a cabin designed to accommodate thirteen passengers A completely equipped galley and provision cabinet is built into the rear wall.

Right: The headquarters at Schiphol Airport The building in the background is the K.L.M. shop and the large machine on the apron is the four-engined Fokker "Flying Wing" The airport is 10 ft below water level in the canal that borders it and is dyked in the good Dutch fashion

Below: Work order form on which mechanic time is entered for maintenance jobs in K L M shops



Although of course a considerable amount of fabric has to be removed from fuselage and tail surfaces to make the inspection properly complete at the time of overhaul, even there the structure may not be so stripped as to require complete recovering The treatment of the fabric is peculiar It is first given priming coats of a red dope, which shrinks it strongly and has excellent protective qualities Over that is applied, for appearance and to ward off the direct rays of the sun, a specially-developed blue paint which has a solvent entirely different from that of the priming coats The paint can easily be removed—in fact it can fairly be brushed off the surface with a brush soaked in the appropriate solvent, no scraping and almost no rubbing being necessary—and a surface of superficially bad appearance may be found, when the cracked and faded paint has been cleaned away, to have the priming coat in as good condition as ever and the fabric as strong as when it was new

The steady flying day after day, especially through the tropics in the monsoon season, is as great a strain on the passengers as on the crew, and their comfortable completion of the trip can be assured only if they are given the best traveling conditions and plenty of room to move around The three-engined F XVIII Fokkers mostly used on the service would normally have room for a crew of two and about ten passengers On the Indian flight they carry a crew of four, as already noted 1,000 lb of mail, and only four passengers The passengers' seats, spaced 5 ft from back to back, are welded up out of electron metal (a magnesium alloy) tubing with leather stretched over them, weigh but 8 lb each The cabin interior is finished with a very simple paneling of bakelite plywood a material found peculiarly suitable for tropical service Much of the cowling like the chairs, is of magnesium alloy So are the wheels The ordinary three-ply type of safety glass has had to be removed from the cabins and replaced with a single play safety glass, heat-treated to prevent splintering, as the three-layer type grew badly discolored and blistered in the tropical heat and moisture

There are a few unusual accessories on the Indian machines The most novel is a cartridge, or pistol, type of engine starter Inertia starters were first used but their use in the tropics was found to be exhausting to the crew Electrical starters have been objected to on the ground of weight and supposed fire danger The use of the pistol type, with the sudden pressure rise that it induces in the cylinder, has caused some alarm among engine manufacturers, but Mr Plesman reports that "this system of starting the engine has been employed by the K L M thousands of times without any detrimental influence becoming apparent on the cylinders, connecting-rods, or pistons"

Aside from the well-known features customary in Fokker design, the most striking mechanical innovation from the American point of view is the use of welded electron metal tanks Slightly flattened cylinders in form and installed in the center section of the wings, the tanks hold 190 gal. each and weigh only about 40 lb., or barely 0.2 lb per gal. Deutsche Lufthansa, which has also done much work with magnesium-alloy tanks is more skeptical about their immediate serviceability and considers them still as experimental Experience with the material depends to some extent on the fuel used, as the electron tanks prove quite unsatisfactory for use with doped fuels or benzol

European operators advertise their air services in poster of many colors

Art in air travel sales

IN EUROPE most transportation is sold through travel agencies Even railroad tickets are commonly bought there instead of at the station The agencies are copiously decked with posters advertising all sorts of trips and travel devices, and the airlines have quickly pushed themselves into a leading position in the application of art to salesmanship Unfortunately the black-and-white reproductions on these pages cannot do justice to the originals with their delicate pastel blues and pinks and flaming reds and golds, but they give some indication of the boldness and picturesqueness of the designs. Though American conditions are quite different, such posters could often be displayed to great advantage here. Air transport executives and traffic managers, please note.

The Union Jack reproduced in its own colors backs the duller tones of the globe in Imperial Airways' poster

Garish reds, yellows, greens and purples call the eye to the Farman display.

In the rich tones of a tapestry K L M paints its transport against the spectral galleon of the Flying Dutchman.

Aeropostale emulates the brilliance of a southern sunset blending scarlet into gold.

In bright orange Luft Hansa's legend and the terminal cities of the advertised route accent a yellow plane against a dark green ground

Air-Union photographs its airliner against a cloud formation of deep azure and white

Almost all the world's airplanes are represented on the Chinese aeronautical scene. While American manufacturers at present have the edge on the promising market for both civil and military aircraft developing there, close study of the peculiarities of the country and its commercial practices will be necessary to maintain it.

The Dragon in flight

A Picture of Civil and Military Aviation in China

SWIFT MOVEMENT from place to place is not an essential element of Chinese tradition Three long and navigable rivers and an intricate system of canals, 65,000 miles of which connect with Shanghai alone, form the chief means of communication in Central China today as they did in the days of the Empire Most surface transportation is of the same date, with improved roads for only about 400 miles, about a third the length of those in Rhode Island Earth, sand clay, and gravel roads throughout a country a fourth again as large as the United States are only six times the length of those in our tiniest state

Amphibions follow the Yangtsze

Against this background the development of air transportation in China is remarkable There are two airlines operating at present, both Sino-Foreign in organization The controlling interest in each case is held by the Chinese Government while minority holdings and responsibilities for operation lie respectively with the American and German interests associated with aircraft manufacturers in their respective countries The American-operated line, China National Aviation Corporation, whose Curtiss-Keystone amphibions have been following the Yangtsze River from Shanghai through Nanking, Anking and Kiukiang to Hankow for several years, was extended some 200 miles further on to Ichang during 1931 More recent extensions include Chungking, at the further end of the world-famed Yangtsze Gorge, and make Chengtu the terminus of the route Chengtu is entirely surrounded by the mountains which rim Chungking, and about 1,000 miles inland, due west of Shanghai Airplanes cover in seven hours the 600-mile stretch between Hankow and Chungking, which for the river steamers is an eight to ten-day struggle against the swift dark Yangtsze current. Both mail and passengers are carried on the line

During 1931 the same company operated a service between Nanking and Tientsin and Peiping, capital city of the north This has been discontinued pending the establishment of a direct route from Shanghai to Tientsin via Tsingtao, a single day's trip. Other routes under consideration will extend the American-operated network to most of the important centers of China; will link Hankow with Sianfu across the fertile and populous valley of the Han Kiang, Yangtsze tributary, will connect the southern port of Canton with Shanghai along the coast route A line with light planes carrying mail only is also planned to connect Canton with Kiukiang, about 500 miles due north The only weather information for aviation purposes available in China is broadcast by the American company which maintains its own radio chain and meteorological service

Direct air mail service from China to Europe through Russia was the original motive for the establishment of the Sino-German airline, known as the Eurasia Aviation Corporation The difficulties involved in crossing outer Mongolia and Russia were found to be insurmountable at the time, so the line which had been opened between Nanking, Peiping, Lanchow and Loyang was discontinued. Preliminary surveys and pioneering flights are under way now for a different route between the continents, from Peiping west through Lanchow, Tihwa and Tscheng, on the Russian border This company recently opened mail and passenger services connecting both Nanking and Peiping with Lanchow on ten-hour schedules Junkers planes fly the routes

Japanese occupation of Manchuria has resulted in five commercial lines radiating from Mukden, its metropolis They are operated by the Japan Air Transport Company which flies Junkers and Fokker single-engined planes. The lines connect Mukden with Tsitsihar, on the South Manchuria Railroad, with Dairen at the southern tip of the province, with Antung where connection is made for Toyko, and with Chinchow, center for aerial operationa in Jehol. The fifth line connects Changchun, further to the north, with Lungchingtsun Passenger service only is provided, except on the Mukden-Antung route which carries mail for Tokyo

Both Air Orient and Imperial Airways are planning to extend their Asia lines further east across Indo China to Hongkong Direct air connection between Europe and the Farthest East will then be available though by the longest way round.

Air force training and equipment

Military aviation, however, dominates the Chinese aeronautical picture. Recent improvements in the national government air force organization are the work of the Commanding General of the Aviation Bureau, retired late in 1932 Under his direction the Aviation Institute was divorced from the National Military Academy, placed directly under the Aviation Bureau, and removed to Hangchow where aviation training could be carried on in comparative isolation from other governmental and political activities

Jane's All the World's Aircraft

In China the repair shop goes to the airplane. This floating dock plies the tidal waters of the Yangtsze

This Central Training School forms the nucleus and headquarters of the air force for the development of which China last summer secured the services of an American faculty, headed by John H Jouett, formerly a colonel in the Air Corps and formerly in charge of the aviation department of the Standard Oil Company of Louisiana Nine pilots and four mechanics compose the group, under three-year contract Initial move of the American group was to sponsor the purchase of fifteen training planes (Consolidated Fleets), standard equipment in many American schools Parachutes of American design were also secured as a basis for instruction in their maintenance and use

Planes of American manufacture are favorites with the Chinese Air Force A squadron of two-seated fighters, German designed, Swedish-built, are by way of exception, as is the polyglot sprinkling of individual combat planes of various design and origin Military aircraft are not limited to military activity Their program of bandit and rebellion suppression is supplemented by taxi-service for officials and messages, where other means of communication are inadequate Training and transport planes, on the other hand, on occasion have been pressed into light bombardment and observation service, especially in internal disturbances

Nominal allegiance is owed to the Central Government at Nanking by all China Proper Actually, various political subdivisions are practically independent, and maintain independent aeronautical organizations In addition to the South China Government at Canton, there is some activity at Peiping in the north, Chungking, in the mountainous interior at the end of the Yangtsze Gorge, and at Yunnan, a mile-high city further to the south Each of these is a potential market for American aircraft and must be contacted separately

An open market; U. S. planes lead

While an official taboo on private flying and the limitations on transport operation practically define China as a military market, it is one almost entirely open to foreign development Abundant raw material is available, but lack of basic industries for its treatment has limited manufacturing activities to rebuilding imported planes A factory in Canton which in the past several years has turned out 22 planes, powered with American engines, is the exception

The distance by which American aircraft lead the field in China is evident from the 1931 import figures, the latest available in any completeness China purchased 22 light bombers, ten light attack planes, six trainers, one tri-engined transport, and four amphibion transports, two twin and two single engined, from American manufacturers in that year Twenty-five separate engines and sundry accessories and spares brought the total to over a million gold dollars Runner-up was Great Britain whose factories sent three pursuit planes, three light pursuits and 30 trainers (most of which are now in the hands of the Japanese) Germany sold ten two-seater fighters, with American engines Six engines were sent direct from their source for installation in China, while the others went through Germany and were not included in the American total Only one French plane, a pursuit type went direct to China, but others with it as ultimate destination were sent first to French Indo-China and trans-shipped from there

There is no question of the American lead, but to maintain it is another matter. Constant consideration of both Chinese business methods and general conditions is essential Consider the airport situation where country-side is not mountainous, tiny farms and rice paddies break up the level Empty fields are studded with burial mounds of innumerable ancestors not noticeable at a distance, but spelling crack-up to a plane on close contact. Poor surface and restricted area characterized the listed landing fields (of which there are over 100) Landing speed is obviously a vital factor With speed concepts tuned to junk and sidewheeler on the rivers and wheelbarrow, caravan, and at best railroads operating at about half the speed of the American variety, aircraft of even moderate cruising speed are satisfactory additions

Direct dealings between manufacturer and buyer, and demonstration planes on the spot are axioms of successful selling in China. While a local representative with extensive personal contacts is essential, experience has shown that he should be known as factory representative—and not be duplicated Chinese purchasing authorities are suspicious of possibilities of price-cutting and bargaining implied in price quotations from numerous sources Made sensitive by unfortunate foreign contacts, they are quick to resent the manufacturer who does not consider them important enough to rate a regular representative So long as "face" retains its importance in the Chinese scheme of things, the manufacturer who best preserves his own has the edge on competition

E D I T O R I A L S

AVIATION

EDWARD P. WARNER, *Editor*

The New Deal and the air mail

GREAT EVENTS impend in Washington. With the change of administration, a fundamental change of air mail policy has become inevitable. It has been evident for many months that both houses of Congress are profoundly dissatisfied with the present arrangement. Even where there is no urge to make drastic reduction in the air mail appropriation, and on the whole the House of Representatives has been disposed to be generous in that respect, the manner of dispensing the money has come under continuous challenge.

That implies no criticism of the air mail operators, nor of anybody. The insistence on change goes far beyond personalities. It grows out of the teachings of experience, and of the change in economic conditions, and of a determination that the air mail shall be organized on a basis that will positively assure ultimate self-support. The result is the Kelly bill, introduced near the end of the last Congress and reintroduced in the present one. Though the bill bears the name of the ranking minority member of the House Committee on Postal Affairs, it appears from recent reports to have the backing of a majority of the committee. It assumes a corresponding importance.

OF the numerous alternative approaches to the question, the new bill has chosen two and hybridized them. It proposes basic compensation by fixed formula, the same for all operators, payments to depend exclusively upon the amount of service rendered. Then it modifies the abruptness of a sudden change to that purely economic policy by introducing a pure subsidy, to be arbitrarily apportioned to air mail contractors after an examination of their accounts during a transitional period.

Whether through the Kelly bill or something quite different, it seems safe to assume that we shall soon see the end of the complex mathematical rules, semi-annually revised and always influenced by the tense interplay of conflicting forces, which have marked the administration of the Watres Act since 1930. Whatever is done now will be a good deal simpler than the practices of the past, but it need not necessarily be so simple as the Kelly bill in its present form.

Over simplification seems to lie in the proposed flat payment of two-tenths of a cent per pound-mile, supplemented by the limited subsidy grants already mentioned. It would be more positive and clearer, and it would also relieve the Post Office Department of a responsibility for the arbitrary allocation of public funds which no official of an executive department ought to bear, if the flat-payment basis were to be replaced by one on a sliding scale that would make the extra grants entirely unnecessary. Such a change, too, would remove any direct connection between the rate of payment and the net income of the contractor, and it would reduce the over-shadowing importance of the government audit of the contractors' accounts. The fixing of government compensation for supplies or services by an audit to determine the cost proved eminently unsatisfactory during the late war. It is no better in time of peace.

Another feature of the bill that causes some justifiable alarm is the clause that would limit the maximum payment in any event to 50 cents per mile flown. Under the proposed rule there will be no added payment for handling anything above 250 lb of mail. Anything beyond that level might properly be set at a very low unit rate, perhaps as low as 1/20 cent per pound-mile, but the consequences of imposing an absolute maximum limit will be most unfortunate.

WITH a change from the often-shifted formulas of the Watres Act definitely in prospect, it becomes possible to do for American airlines what has been done for a number of European lines during the past ten years. It becomes possible to draw up long-time contracts, providing for the payment of compensation at a strictly fixed rate or in accordance with a formula which will remain constant throughout the life of the contract. It is of the utmost importance that it should be possible to enter into positively fixed arrangements covering a period of at least eight or ten years, permitting a contractor to plan with real confidence for developing his operations over that length of time.

However complete new air mail legislation may be, and however carefully it may be drawn to cover unexpected contingencies, much will still depend on administration. The autocratic power of the Postmaster General to create routes and extend them would still exist under the Kelly bill. It is an open question whether that is not too broad a grant of power to be given to any one official of an executive department, especially where the award of contracts that extend over much more time than the life of one administration is involved. The next few months will offer a good opportunity for studying the desirability of creating a commission, of a more permanent and more purely judicial order than the Postmaster Generalship, to consider and decide upon the major factors of the financial relationships between the government and individual air transport operators. The determination of general policy is, of course, and will always remain in the hands of Congress.

Britannia steps out

ONCE upon a time America used to specialize in holding aeronautical world's records. That period now seems to belong to history. It might be a good idea to try to revive it.

There are three major records in aviation—speed, distance without stop, and altitude. Eighteen months ago two of them were located in America. Today Great Britain holds them all. That is greatly to the credit of the British aircraft industry, and incidentally to the British government, which paid the bills for two of the three records. It calls for warm congratulations to our British friends, and we cheerfully extend them. They have done a splendid job. But it also gives us occasion to do a little thinking on our own account.

TO RAISE the world record for speed from 278 m.p.h. to 408 involved the efforts of several of the leading British airplane and engine factories over a substantial part of a five-year period. It cost the British government a sum which must have been well in excess of one million dollars, together with another $480,000 received from a private donor. As against that the American record has been pushed up to 296 m.p.h. through the efforts of three or four airplane factories of very small size and limited resources, in co-operation with one of the large engine builders and using money provided on a distinctly modest scale by private syndicates. There has been no government encouragement of any sort, and none of the largest airplane manufacturers have shown any interest in the subject of record-breaking.

The British have just recaptured the distance record. They have spent six years going after it, again at government expense, and again with equipment specially constructed by one of the largest of British manufacturers. The final outcome has been a flight of 5,341 miles, beating by only 7 per cent the figure established by Boardman and Polando in a slightly modified machine of straightforward commercial type, and with a total preparatory cash outlay considerably less than one-tenth of the amount expended by the British authorities.

A year ago Great Britain won the altitude record back from the United States. On that occasion the venture was a private one, with the builder of the power plant that was used taking the leading part. In going to the expense of remodeling an airplane and making all the necessary special installations, the Bristol company showed an initiative which has not been paralleled by any American manufacturer in the last three years. Presumably their interest was not purely altruistic, and did not proceed purely from sportsmanship. There is a real commercial advantage in record-holding, especially when foreign markets are to be invaded. It might be well worth the while of some of the more powerful units in the American industry to organize for the recapture of important records, even though they had to do so entirely at their own expense.

WE HAVE never been in favor of racing with government support as a regular thing. The costs are high, and the benefits questionable. Nevertheless we believe that it would be well worth while under present conditions for the Army and Navy to take steps to restore some of the leading records to American credit, leaving the manufacturers as free a hand as possible in the development of the record-breaking machines. There isn't the slightest doubt that American builders can produce products that will fly at least as fast, as high, and as far, as those of any other country. There is plenty of evidence of that already upon the books. All they need is an equal chance. We should like to see the government services offer an incentive by announcing their willingness to purchase at a reasonably substantial figure a few experimental machines which the manufacturers would guarantee to break specified records now held abroad. Some $1,500,000 of the appropriations for experimental work could be very profitably expended in that way over the next three years. Given such a spur, we hope the American industry could be counted upon to respond, and to show confidence in its own products and willingness to take some risk upon its own account.

NEWS OF THE MONTH

Planes pave the way

FROM the apparent security of his mountain stronghold, Jehol's metropolis Chengteh, its Governor, Marshal Tang Yu-lin, taunted Japanese and Manchukuan invaders for their reliance on modern methods of warfare Confident in superior numbers, he assured the world that "airplanes never capture any objective" Today, while Tang rues his words in some dark hide-away, Japanese planes sally forth from their new base in his capital city to bomb away more stubborn Chinese resistance along the southern border of his province and along the Great Wall itself. Intermittent bombardment by Japanese planes had cut the way for ground forces attacking Kailu and Chaoyang, key cities of northern Jehol; had raked his troops massed along a 40-mile line of defense near Chengteh, but unprotected by anti-aircraft guns; had dropped supplies to Japanese troops struggling along mountain passes, and propagandist and seditious literature to his own troops and civilian populations. Blizzards and weather playing around the 20-deg.-below-zero mark put the only restriction on Japanese aerial operations, conducted largely from their base at Chinchow Thirty-four Chinese planes had been reported sent to Tang's assistance, but were not in evidence when two Japanese aircraft bombed the new airport at Chengteh

Peruvian and Colombian aircraft almost monopolize the war stage in Leticia, though both decline the responsibility for having opened hostilities In several cases anti-aircraft guns on warships in the Amazon are reported to have kept them at too great a distance to be of much effect.

France has a plan

General agreement to the thesis that some international control of civil aviation is necessary for the abolition of war aviation is the sole progress reported to date by the air committee of the Geneva Disarmament Conference formed at British suggestion to consider the League's air policy. Diametrically opposed views of the problem find small hope of reconciliation in the French plan presented by M Cot which the committee will study before taking any action France again urges complete control of all civil flying creation of an international air force to punish war-makers Germany expresses virulent opposition, withdrawing even the concessions previously made to the principle of international control So does America So does Russia Great Britain seems not quite sure, but in any event insists on a free hand in "certain areas" (presumably related to India and Egypt)

Germany has a Minister of Air

Aviation in Germany, until recently a subordinate division of the Ministry of Transport, under the Hitler government has assumed the importance of a ministry The new Reich Commissariat for Aviation has as its head Captain Hermann Wilhelm von Goering, a distinguished War pilot and Commander of the Richthofen Jagd staffel (pursuit squadron), who as Hitler's lieutenant became President of the Reichstag He is now also Minister of the Interior for Prussia and Reichsminister without portfolio Ehrhardt Milch, long technical director of Luft Hansa and now Secretary of State for Aviation, will be executive assistant to Captain Goering Unless the unexpected happens at Geneva and military aviation is abolished, a matter of first consideration to the new Commissariat will be the establishment of a military aviation corps (supposedly prohibited in Germany by the terms of the Versailles Treaty) German civil aviation was promised solid financial backing by Captain Goering in a speech at the 25th anniversary celebration of the Aero Club Opening the German Aeronautics Exhibit at Essen a week later he promised firm resistance to the efforts of the disarmament conference to control it.

Appointment of Capt Friedrich Christiansen, commander of seaplanes in the North Sea during the War and known to American aeronautical circles as commander of the Dornier flying boat DO X, as Director of the Air Sport Department was one of the first acts of Germany's first Air Minister. As head of the Naval Aviation Department Captain Goering chose Captain Wolfgang von Gronau, whose flights to the United States by the northern route are an annual event The seaplane training school at Warnemünde is the usual scene of Captain von Gronau's activities.

Budget cuts

Prunings of the French budget under the economy regime of Premier Daladier gave full reign to the rhetoric and righteous indignation of the French aeronautical press Mass meetings of protest and editorial invective were equally futile in their efforts to change the aeronautical appropriation as stated in the budget bill as it finally secured the reluctant approval of both Senate and Chamber after an unprecedented amount of jockeying back and forth between the houses The amount allotted to aviation is 26 per cent below the budget figure for the year 1932, more than twice the cut made in the provisions for the Ministries of War and Navy Since the expenditures for personnel and maintenance are practically fixed, the brunt of the economy falls on the procurement of new material, much as has been the case in the United States in the past two years Allowance for that purpose is practically cut in half

The Czechoslovakian Government has cut with even heavier hand her budget for civil aviation in 1933 The appropriation, amounting to just under $1,000,000, gives a third less than the 1932 figure Cuts in subsidies to airlines and in provision for the maintenance of air force and landing fields account for the major part of the saving

French transport comes of age

After years of waiting, French commercial aviation has finally received legal recognition and definition. Chief provisions of the statute introduced in the Senate by M de la Grange (a frequent visitor to America, and close student of American aviation), are that contracts concerning the activities of air navigation companies must be passed upon by the Minister of Air, that long-term subsidy contracts can be made to bind the government for as much as fifteen years, that the executive control as well as the majority of the capital of such organizations be in French hands; that revision is possible every five years; and finally that the Minister of Air can specify that up to half the planes and engines purchased by the subsidized companies be from manufacturers not closely affiliated with them.

New deal

Two of the assistant Postmasters General may become trump cards in aviation's hand in the new deal at Washington. Second assistant, whose province in previous administrations included air mail matters, is William W Howe, of South Dakota. Fourth assistant, usually concerned with finance and accounting but expected in this instance to take a special interest in things aeronautical, is Silliman Evans who was vice-president of American Airways in charge of public relations. Mr. Evans was previously in charge of publicity on the old Southern division of American Airways No appointment has as yet been made for Assistant Secretary of Commerce for Aviation. Rumor has mentioned the formation of a special transportation board under whose jurisdiction will come airways, as well as railroads and shipping.

In a change of heart before adjournment, the Lame Duck session once again cut air mail appropriations. After the Conference Committee had approved the bill at $19,000,000, the Senate refused it, throwing it back on Conference whence it emerged a second time and was accepted at $15,000,000. Another amendment to the Reconstruction Finance Corporation act removed aircraft suitable for overseas transport and their essential port facilities from works for which loans may be made to private corporations

Ranger floats

Impressive ceremonies at Newport News, Feb. 25, launched the first vessel of the United States Navy designed and built as an airplane carrier. Named Ranger, after the ship built for Captain John Paul Jones by the Continental Congress in 1777, it has a standard displacement of 13,800 tons, barely half the size of the Saratoga and Lexington. Experience has shown them to be too large and vulnerable for most efficient use with the scouting fleets. Upon the commissioning of the Ranger, scheduled for May 1, 1934, the United States' aircraft carrier tonnage will total 91,300, less than three quarters of the London Treaty allotment Though an act of Congress in 1929 authorized the construction of the carrier, no provision has been made for its complement of 114 airplanes.

To incorporate in the Ranger improvements developed since its design in 1929, before the Saratoga and Lexington had taken any active part in fleet maneuvers, Representative Vinson of Georgia introduced into the House a bill to authorize an increase in its limit cost to $21,000,000 The extra $2,000,000 has been approved by the House, but awaits Senate action. This revision will change the Ranger from a flush deck carrier like the Langley with sinking bridge and side funnels to an island type like the Lexington and Saratoga with stacks and funnels at the edge.

Another Navy airship

On the other side of the Mason-Dixon line, just two weeks later, the Akron's sister airship ZRS-5 was christened Macon and took to its appropriate element at the Goodyear-Zeppelin dock in Akron, Ohio It is the last number on the Navy's airship-building program, authorized in 1926 A Navy crew of thirteen officers and 75 men is standing by until March 30 when flight-testing is scheduled to begin Upon completion of trials and final acceptance by the Navy, the airship will proceed to the Naval Air Station especially designed for it at Sunnyvale, Cal.

Completion of the Army's five-year plan for Air Corps expansion, at least with respect to the number of fighting units, was accomplished by retiring Assistant Secretary of War for Air Davison. His approval of orders for the organization of five additional pursuit squadrons brings up to 51 squadrons the strength of the Army Air Corps, which consisted of 32 squadrons when Mr. Davison took office in 1926 With respect to flying equipment, the program is no nearer completion than at this time last year. Shortage of planes and the demands of economy will prevent most of the squadrons from operating at full strength. Newly dedicated Barksdale Field at Shreveport, La., will receive one of the new attack squadrons, two go to Albrook Field, Panama, and the last two to Selfridge and Langley Fields, with Hawaii their eventual destination.

Air transport in the East

Plans for new routes or extensions come from both the Near and the Far East. A service from Athens to Alexandria, on the other side of the Mediterranean, with the Island of Crete as halfway mark is scheduled to start in June. It will be run by the Greek Air Transportation Company which now maintains regular schedules between Athens, Thessaloniki, and Jannina. The purchase of single-engined planes is being considered, to replace the 14-passenger tri-motored Junkers planes used on the company's present services Increased traffic on Imperial Airways' line between Greece and Egypt is responsible for the creation of its new competitor.

Both Imperial Airways and Air Orient have projected services over Indo-China. The French company, with the approval of its government, plans to extend its Marseilles-Bangkok-Saigon service started two years ago to Hanoi on the east coast of the Malay Peninsula Operated provisionally last December, the Bangkok-Hanoi schedule will be weekly with the prospect of extension to Canton and Hong Kong Hong Kong is also the terminus of a

Calendar

May 28	Deutsch de la Meurthe Cup Race, Paris France
June 12-July 19	Soaring Camp Elmira, N Y
July 1-4	National Air Races, Los Angeles.
July 1 4	Chicago Air Races, Chicago.
July 10-23	Fourth Annual National Soaring Contest Elmira N Y
September	International Gliding Congress and Meeting La Banne d'Ordanche (Clermont Ferrand) France.
December	International Rally Cairo Egypt
December 14	Meeting of the Federation Aeronautique Internationale Cairo Egypt

NEW BOEING TRANSPORT ON THE JOB

Preparatory to regular service on United's San Francisco-Cheyenne run the first of the twin-Wasp-powered transports completed at the Boeing plant in Seattle takes aloft a load of passengers. (See page 124)

route planned by Imperial Airways as an off-shoot from its England-Australia service at Rangoon, Burma.

Speed in Denmark

A new two-hour express service between Copenhagen and Berlin was started early this year by the Danish Air Transport Company. Flying in a direct line over water almost half the time, it makes the 220-mile trip in much better time than the old service which made a wide land detour, over Lubeck-Travemuende. Sixteen-passenger Fokker F12 tri-motors (Bristol Jupiters) are substituted for the single engined Fokker F-7's which the company used on the land runs. License for the construction of the Fokker F-12's has been secured by the Royal Naval Dockyard at Copenhagen, where the first plane is now being built.

Italian and German planes are making their regular bi-weekly trips between Venice and Munich across the Alps during the winter for the first time this year. In previous years they went into seclusion some time in October. Hornet engines built under license at the Bavarian Engine Works at Munich power the Junkers tri-motors used on the trans-alpine service. They were among the fourteen Ju 52's recently completed for Luft Hansa at the company's Dessau factory.

Rate changes

Applying the principle of charging what the traffic will bear, Imperial Airways have raised their rates on certain runs and reduced them on others. One-way fare to Paris is increased 5 shillings, the fifteen-day round-trip ticket is up 17 shillings on the ordinary services, and slightly more on the de luxe Silver Wing run. No change is made in the one-way fares to Brussels, Cologne, Basel, or Zurich, but the fifteen- and thirty-day round-trip tickets are much reduced, in some cases as much as $5. Putting a premium on patriotism, reduced rates on Imperial Airways and the other four airlines operating in England, as well as on the Compagnie Generale Transatlantique may be obtained by air travelers who belong to the Air League of the British Empire. Imperial Airways has also become more generous in its treatment of more substantially built passengers. A passenger weighing more than 187 lb is now allowed 33 lb of luggage free of charge, instead of having to content himself with the difference (if any) between his personal weight and 220 lb as heretofore.

Reduction is the order of the new passenger tariffs in effect on the lines of the Mediterranean Aviation Company. Cuts vary from 10 per cent on the Rome-Cagliari run to almost one-quarter on the line from Venice to Vienna. Tariffs on the company's line in Albania connecting Tirana with three other important cities in the country, are slightly higher.

AN INSIDE STORY

Looking forward inside the Macon as its twelve gas cells, ranging from 100 000 to 900,000 cu ft capacity were being inflated.

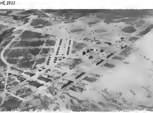
Night flight

Northwest Airways have added a third daily service on their Twin City-Chicago run, which leaves St. Paul at 7 25 p.m. to arrive in Chicago at 11 15. A 12 30 a.m. departure from that city brings one back to St Paul at 4 55 in the morning. Changes made on the company's lines to Duluth, Bismark, and Winnipeg, provide connection with the night service. The new schedules make it possible to leave New York at 5 p.m. and reach the Twin Cities at 4 55, and Duluth at 10 12 the next morning. Departure from Winnipeg, Manitoba shortly before 1 p.m. permits one to reach New York the next morning before the business day begins. The same trip by rail would take at least two days and two nights.

Though night flying on regular airlines abroad is almost negligible at present, a change is coming. Night air mail service in Sweden, which has been operated from May through September since 1928, is to be maintained the year round. Planes of the Swedish Air Transportation Company leave Stockholm and Gothenburg early in the evening to meet at Malmo where the mail is transferred to planes scheduled to arrive in London, Berlin, Amsterdam, and other continental cities early the following morning.

Airway communications

Two-way short-wave radio communication is another matter. In preliminary tests of apparatus designed for installation in the new four-engined planes ready for service on the Cairo-Cape Town route of Imperial Airways, communications were established at record distances. The wireless operator of a Short flying boat conducting the experiment several thousand feet above the White Nile between Juba and Kampala maintained two-way communication with Portishead near Bristol, England, contacted Norddeich, Germany, some 5,000 miles distance, and received news messages from Miami Beach, Fla. While contacts of this sort can be effected occasionally they cannot be depended upon, as they vary considerably with weather and other conditions.



NEWEST AND BIGGEST

Barksdale Field at Shreveport, La., recently dedicated, is the home of the Army Air Corp's 3d Attack Wing. The 20,000-acre reservation is the largest airport in the United States.

Boston's long beam

By a slight adjustment of its beams the radio range beacon at Boston lends a hand to airplanes catapulted from the liners Europa and Bremen in the ship-to-shore mail service. Established for radio directional service on the New York-Boston Airway, the Boston beacon has one course extending 200 miles out over the Atlantic Ocean. Shifting this beam to pass directly over the tip of Cape Cod, first landfall for the aircraft, provides a course which the planes can follow to the coast, regardless of weather conditions.

A design for landing

A further addition to the systems of radio aid now common to American airways was demonstrated several times at Newark Airport during a snowstorm early in March. Developed by the Aeronautics Branch, it permits landing at busy airports in fog or even completely blind. A visual receiver reporting the distances from the airport, beginning at about 5 miles out, a runway beacon indicating the direction of the runway, and finally a curved landing beam projected tangent to the ground to an altitude of several thousand feet are chief components of the system. The equipment required in addition to standard receiving apparatus is quite simple and weighs only 15 lb.

California's mission

Airport rating, the enforcement of state aviation law, and problems of movie censorship were featured at the state-wide aeronautical committee meeting with which the California Chamber of Commerce began the year. California is engaged in missionary work on a compulsory airport rating plan involving 176 airports, which it hopes may extend throughout the country, only 7 per cent of whose airports are rated at all. The committee on movie censorship reported success in securing revisions of the script of two forthcoming productions which originally gave an inaccurate and alarming impression of air transportation. The example of the Los Angeles Chamber of Commerce was followed in securing the agreement of air transport companies to refuse to co-operate in the making of a movie until its entire script has been examined and approved.

National Air Races

Los Angeles is to be the scene of the 1933 National Air Races. Cleveland whose five year option gives her first choice for the races until 1935 has relinquished them this year to the California city where they were held in 1928. Chicago was host to the meet in 1930 after which the contract was signed bringing it back to Cleveland where it had been held for the first time in 1929.

Airport traffic control

Supplementing the air traffic rules which are concerned mainly with the maneuvering of aircraft in the air are the recommendations contained in the report of the Committee on Airport Traffic Control released by the Aeronautics Branch on Feb. 15, for the control of aircraft in the vicinity of airports and on the ground. After a preliminary report published in December, 1930, outlining the progress of investigations to date, 28 subcommittees at representative air terminals in different parts of the country were organized to make the first-hand analyses of traffic-control problems which form the basis of the final report. To profit by the experience of highway traffic showing the desirability of a maximum degree of uniformity in regulation, the committee made a detailed study of the various types of signaling equipment and plans of traffic flow in use at airports which have already outgrown the simpler regulations contained in uniform field rules. The committee, organized in 1929 by then Assistant Secretary of Commerce for Aeronautics Young, is made up of representatives of the Aeronautics Branch, the Aeronautical Chamber of Commerce, American Engineering Council, the N A C A, the Bureau of Standards, and the air arms of the two military services.

For better private pilots

More time and less money is involved in securing a private pilot's license under the terms of a recent amendment to the Air Commerce Regulations. Fifty instead of ten hours of accredited solo flying time will be required of candidates for the grade of private pilot. Thus the flying experience required for an amateur pilot who would carry his friends as passengers is the same as for a professional pilot of limited commercial grade, who may carry passengers for hire. The amendment, which abolishes the already almost extinct grade of industrial pilot also creates a new grade, "solo pilot." All the privileges heretofore enjoyed by private pilots, except that of carrying persons who are not pilots, go with the solo pilot's ticket, for which ten hours of solo flying are necessary. Largely responsible for the new requirements are analyses of accidents showing a large proportion traceable to pilots with less than 50 hours flying experience.

Applicants for transport and limited commercial pilot licenses now pay only $10 to the physicians conducting their original physical examinations, instead of the previous $15 fee. Medical examiners designated by the Aeronautics Branch to conduct the physical examinations required by the Air Commerce Regulations will reduce their fee for private and student pilots to $7 50 a saving of $2 50. A similar fee is charged for the annual re-examination. Mid-year check-ups for transport and limited commercial pilots continue to cost $5.

On the heads of 222 violators of the

Air Commerce Regulations fell the hand of the Aeronautics Branch during the last quarter of 1932 Total offenses during the preceding quarter had been almost a third again as large As usual, violations of the low flying clause led the list of specific offenses, with inappropriate acrobatics and the flying of licensed aircraft by unlicensed pilots of almost equal frequency

New projects

A newcomer to American air transport circles is the New York and New England Airways, Inc., of which Col. Clarence D. Chamberlin is president A three-a-day service out of Holmes Airport in Jackson Heights, L. I., to Hartford, Conn., is to be extended eventually to other New England cities An air travel and information bureau in the Times Building, New York, open day and night to answer the public's questions about aviation, is another recent creation of Chamberlin, Holmes & Company Ruth Nichols is in charge of the bureau, whose special feature is a charter service for emergency trips always on call.

Notes in Business on the air

In a weekly dramatization of business news events broadcast by Station WLW of Cincinnati, aeronautical items are frequently included The "Notes in Business" program is on the air each Saturday night from 7 30 to 8 o'clock. An advisory committee of business editors, of which the editor of AVIATION is aviation member, act as consultants, and supply specialized information for the program Any suggestions for aviation news to be dramatized over this station may be forwarded to the offices of AVIATION.

Air topics program of a more general nature are broadcast three times a week over KMOX at St Louis Sponsored by Parks Air College and directly handled by George E Bounds of that institution, the fifteen-minute program is scheduled for 10 p.m each Monday, Thursday and Saturday.

Cord control

Additional purchases of Aviation Corporation stock by E. L. Cord and his associated interests have sealed their victory in the struggle for control of the company, precipitated last November (AVIATION, December, 1932 and January, 1933) by a move to acquire the assets of North American Aviation. Eight members of the compromise board of directors which was established by way of truce have resigned Among them is Richard F. Hoyt who was elected president at that time Under the new regime Mr. Cord is president of the board, L. B Manning president and Raymond S. Pruitt secretary and general counsel Lester D. Seymour, elected president of American Airways last December, retains his office The offices of Aviation Corporation and all its subsidiaries are being moved to Chicago where American Airways was established a few weeks ago

Popular-priced Pitcairn

Another price cut brings the Pitcairn autogiro neatly into the under-$5,000 class The Kinner-powered model PA-18 now sells for $4,940, a reduction of $500 Giro Sales & Service, Inc., at Roosevelt Field have added the Pitcairn line of autogiros including the new four-passenger cabin models, to the Kellett autogiros for which they have long been dealers

Turkey buys British

Vickers Aircraft, Inc., is the first British firm to receive an order from the Turkish Government in many years The contract is for six twin-engined flying boats of the Southampton type, powered with 530 hp Napier Lion water-cooled engines, to be built at the company's Supermarine works Twenty-four Hawk pursuit planes from the Buffalo plant of Curtiss Aeroplane & Engine Company were delivered to the Turkish air force not long ago, and are to be manufactured in Turkey under license

Built under license

Also accompanied by a purchase of manufacturing rights is a repeat order which has been received from Denmark by the British Hawker Engineering Company. Powered with 480 hp Rolls-Royce Kestrel engines, the Nimrod single-seater fighters ordered are for the Danish Naval Air Service

Kawanishi Aircraft Company of Naruo, Japan has just completed a third KF1 flying boat under license from Short Brothers, Ltd., of Rochester, England. Upon successful completion of flight tests the 20 ton craft was delivered to the Japanese Navy With the exception of three Rolls-Royce Buzzard engines the ship is built entirely of Japanese materials.

Annual Reports

Douglas Aircraft Company's report for the year ending Nov. 30, 1932 is written in its usual black ink. Net profit, after federal taxes, loss on sale of bonds and other charges is $71 622 This earning of 20 cents on each of 356,435 no par capital shares must be compared with $1.60 a share on 342,403 capital shares the year before when net profits were $549,331 Though the company's net sales dropped 40 per cent during the year, total assets have been maintained at the 1931 level, and cash and marketable securities are somewhat better than at the end of the preceding fiscal year.

While the Ex-Cell-O Aircraft & Tool Company shows a net loss after depreciation, interest, expenses and other charges of $167,557, for 1932, its position is a decided improvement over the previous year when losses totaled $259,109

1932 reports of Nicholas-Beazley Airplane Company and Transcontinental Air Transport also showed a slight improvement over 1931 Net loss of the airplane company, including the flying school's losses and other charges, was $63,988 as against $69,530 in the previous year T.A.T lost $72,166, after depreciation, expenses and other charges as compared with $72,723 in 1931.

A British firm, the Fairey Aviation Company, reports the proud achievement of an increased profit and turnover for every year since formation Net profits for their fiscal year ending Sept 30, 1932 were £198,510 as compared with £184,585 at the end of the preceding year, and £164,953 on Sept 30, 1929 Cash surplus after the payment of a 10 per cent dividend is also larger than at any time in the company's history That conversion into dollars brings current profits, on a gold basis, to below the 1931 figure, owing to a drop of about $1 in the rate of exchange during the past year does not alter the satisfaction of the British stockholders

Overseas operations resulting in deficits for its three subsidiary companies in Australia, Canada, and South Africa brought the net profit of De Haviland Aircraft Company of England down to £2,200, as compared with £27,700 at the end of 1931 The De Haviland Company of Canada ended its fiscal year on Sept 30 with a net loss of $29,155, as against a profit of $656 before federal taxes in the preceding year

Personnel

Edward V Rickenbacker, an outstanding figure in aviation since War-times when he was making his reputation as America's premier ace, has resigned from American Airways as vice-president His offices in the Chanin Building will be maintained until the formulation of his plans for the future are complete

Lieut.-Col. Albert P Clark, Medical Corps, has been designated Commandant of the School of Aviation Medicine at Randolph Field, Tex. He will also serve as Post-Surgeon and Flight-Surgeon of the Air Corps Training Center

Capt Kenneth Whiting, naval aviator since 1913 and Commanding Officer of the Naval Air Station at Hampton Roads, Va., has been assigned to duty as commanding officer of the aircraft carrier U S S Langley.

Agnew E. Larsen, chief engineer of the Autogiro Company of America, has been made vice-president. He will continue in charge of the company's development work, which he has directed for the past three years,

SIDE SLIPS

By Robert R. Osborn

Airplane desiga made simple

LATELY we have been very much surprised to find that airplane design and construction seem to be very mysterious to some people associated directly with the industry, as well as to the general public. They have no idea why a biplane is used for one type of airplane and a monoplane for the next type They probably wonder why the engine installed was selected, and why the cabin or cockpits are arranged as they are In fact, in some cases they have even wondered why the airplane was ever built. Realizing that some information along this line would probably be appreciated by our readers, we have interviewed a number of experienced designers we know, to learn from them the reasoning and processes by means of which a new airplane is created They were glad to tell us their experiences and we have condensed all of their stories into the following, which might be said to be the high points in the life of an average airplane in its journey from the drafting board to the field.

As his favorite layout draftsman is working up some advertising for the sales department, the Designer is much discouraged to find that he will have to use an inexperienced man and do the figuring and calculating himself

Designer calls for a wing span of 37.5 ft Layout draftsman misunderstands his writing and lays out the airplane to have 375 sq ft of wing area

Airplane originally laid out as a monoplane. New Department of Commerce inspector shifted to the district New Inspector has a great preference for biplanes, so design is changed to a biplane

President sends in word that speed is essential in all new aircraft of the immediate future and airplanes must be designed mainly for speed Design is altered to suit

Engine selected is the one manufactured by the Chief Engineer's golfing partner. Designer asks the world howinell he can turn out a good ship when he has to use an engine like that one? Chief Engineer's golf game gets poorer so that his partner beats him regularly Designer ordered to shift to the best engine available in another company Designer asks the world howinell he can turn out a good ship around an engine like that one?

President sends in a note stating that the watchword is economy, and that all new designs should have cheapness of construction and economy of operation as their major criteria Design is altered to suit.

Designer hears that the Whoosis Airplane Company is laying out a competing model with gull-shaped wings Immediately scraps his design and starts over again with gull-shaped wings Simultaneously, the designer of the Whoosis Airplane Company has scrapped his drawings and starts new layouts using butterfly-shaped wings, after hearing that the Whatsis Airplane Company is proceeding on that basis

President returns from a tour around the country Circulates notes to the effect that the present trend is toward better vision for the pilot, and that all other features including speed and cheapness of construction, should be compromised to obtain better vision. Design is altered to suit

President sends in word that the crying need of this country today is a good 5-cent cigar Design is altered to suit.

Shop makes an error in building the fuselage a foot too short In exchange for previous shop favor in covering up one of his errors, the Designer writes a long treatise to the Chief Engineer pointing out the trend to shorter fuselage lengths, suggesting that the fuselage be made shorter by 1 ft. Chief Engineer does not grasp the full meaning of the obscure parts of the Designer's calculations, so issues order to have the nose of the fuselage shortened by 1 ft Designer and Shop Superintendent talk it over, and decide they had better just cut 1 ft off of the nose and say nothing more about it

Engine finally arrives for installation in the ship Turns out that the engine company had decided to build a nine-cylinder engine instead of a seven-cylinder engine. Engine mount designed for a seven-cylinder engine Long correspondence between airplane company and engine company to determine if two cylinders shall be taken off or if engine mount shall be changed Matter finally settled by flipping coin. Engine mount is changed.

On installation of the engine it is found that the carburetor interferes with the center landing gear fitting Engine sent back to the engine plant to be made into a down-draft carburetor When engine returns it is discovered that the new carburetor interferes with the oil tank Send engine back to engine plant to be made over into a solid-fuel injection engine

None of the shop cowl workers understanding English, Project Engineer waves his arms around in the air to show them what type of wing fillets he wishes Thinking he is referring to the engine compartment cowl, they turn out a startling new idea in engine cowl. Project Engineer has drawing made to suit and sends drawing in to Chief Engineer pointing out that his new design will probably add 4 m p h.

Landing gear was laid out for large diameter wheels Somebody invents small diameter wheels and sells them to the Purchasing Agent When they are applied to the ship it is found that the propeller ground clearance is too small Project Engineer announces that a three-blade propeller will be used because of high propeller tip speeds or something

During set-up operations, upper wing is found to interfere with a beam in the roof of the factory After comparing costs of altering the beam in the roof, or changing one set of wing struts, gap between the wings is decreased by 6 in

First weighing of the ship shows the center of gravity to be badly out of position. Upper wing is taken off and changed to one of large sweep-back, to balance the ship Chief Engineer sends note to President explaining delay as necessary, as sweep-back has to be used to improve the pilot's vision

At the field 1 ft. of left wing tip is knocked off on a hangar door One foot is sawed off the other wing tip to match, and both ends are faired off neatly

The airplane is put over the speed course and is found to have a high speed, 5 m p h more than the Designer expected, but 5 m.p.h less than he wrote in the preliminary specification. This speed, 5 m p h. more then the Designer Engineer expected, and 10 m p h. less than he promised the President. The speed is 15 m p h. more than the Sales Manager expected and 15 m.p.h less than he wrote into the preliminary advertising copy

Knowing his organization thoroughly the speed is exactly what the President anticipated

FLYING EQUIPMENT

Boeing's new Model 247 transport

Between the summer of 1914 and the late fall of 1918, the pendulum of progress in airplane design swung back and forth between the engineering offices of the warring powers. Improvements in detail or in performance were pyramided, scarcely had a superior fighting ship appeared over the front when some speedier and more potent model would take off from the other side of the fence. In a somewhat similar fashion the focal point of design in the United States during the post-War period has tended to oscillate between the commercial and the military, to the great benefit of both. Ideas developed by designers for racers and transports find reflection in subsequent fighters and bombers, and are later handed back to their originators for further commercial use, much better for exposure to military service. Some such cycle has recently been completed by Boeing Airplane Company, United's West Coast manufacturing unit.

In 1930 Boeing engineers broke definitely with the composite-military-biplane tradition, and produced the then-radical Monomail. A year or so later when a high performance bomber was required by the Air Corps, the lessons learned from the production and intensive usage of the Monomail laid the foundation for the YIB-9A bomber. The performance of this ship was so successful that when United laid down the specifications for 60 ultra-modern transports to replace equipment now in service, the swing of the pendulum brought the design with its accumulation of military experience, back to the commercial side of the picture.

Although the new air liner is similar in general form and overall dimensions to the YIB, the underlying philosophy of its design is totally different. Speed, passenger comfort and economy in production, operation and maintenance were the primary considerations. Speed was inherent in the design (the ship ranks with the fastest commercial designs here and abroad), but the other factors had to be built in from the beginning. There was no attempt, for example, to lay down the cross-sectional dimensions of the fuselage from a purely aerodynamic point of view, hoping that somehow, after the job was done, the long suffering passenger would be able to find somewhere to put his feet and to wedge in his personal belongings. Passenger requirements were the starting point. The average passenger was studied for length, width and volume, and the cabin almost literally built around him.

The 20 ft length of cabin has a headroom of 6 ft throughout. The chairs are arranged five on a side, with an ample aisle between. Each is 20 in. wide between the arms and is spaced 40 in apart. A large rectangular window is located by each seat. Reading lamps and hand-operated ventilating and heating ducts are arranged for each passenger.

The position of the two engines in nacelles well forward of the leading edge of the wing, contributes greatly to the reduction of direct vibration. To deaden external noise, cabin walls consist of the outside metal skin, ½ in dead air space, a layer of felt, a sheet of plywood, and for interior finish a layer of felted fabric as a soft inner layer has been found very important in reducing objectional reflected sounds inside a cabin. (For full discussion of sound insulation in airplane cabins see page 106 this issue)

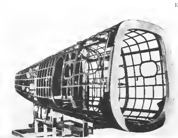
The heating system is thermostatically controlled. A small boiler mounted around one of the engine exhausts, supplies heated liquid to radiators installed in the cabin air supply ducts. About 18,000 cu.ft an hour of ventilating air can be taken in through scoops and exhausted through two outlets in the cabin ceiling. In warm weather the boiler is automatically disconnected, and the system supplies cool air to the cabin, so that under practically all conditions a temperature of about 70 deg. can be maintained. The cold air intakes by each window are independent of the main heating system, and can be controlled by passengers as desired. They are similar to those used on the present Boeing 80's.

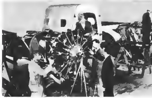
Compartment for pilot and co-pilot is reached through a door in the forward cabin bulkhead. The instrument board is unusually complete, and is fitted up with all the latest aids to navigation developed on United and other lines. Three devices are installed to warn the pilot of the position of the retractable landing gear, (1) a gear position indicator, (2) a red bull's eye light on the instrument board, and (3) a Klaxon on the wall behind the seat. One significant feature of the instrument installation is the use of an engine-driven pump for driving all vacuum-operated instruments in place of the customary venturis. A certain amount of parasite drag and the hazard of ice-clogged venturis are thereby eliminated.

Standard Western Electric two-way radio-telephone equipment is mounted forward of the pilot's cockpit just under the base of the radio antenna mast. A 60-cu ft. mail pit is in the nose ahead of the radio compartment. Access to the pit and to the radio instruments is through a large circular hatch in the forward deck. Another 65-cu ft. baggage compartment is immediately aft of the cabin, reached from outside the airplane through a door on the left-hand side of the fuselage. Since the door for passengers is on the right-hand side of the machine it is possible to load mail and express without interfaring at all with the cabin entrance.

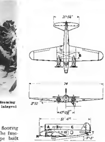
First of Boeing's new transport airplanes ready to go into service on United Air Lines

During the design and construction stages, frequent conferences among engineering, operating and maintenance personnel insured that all possible use be made of accumulated experience in building into the new ship features which make for the utmost economy in use and upkeep. It has become scarcely necessary to mention, in describing modern transport designs, that adequate provision has been made for rapid and complete accessibility to all essential parts of the structure. The same may also be said of the use of ball bearing hinges and fittings at every possible point. All external dural parts have been anodically treated before assembly, and practically every part of the structure, internal and external can be reached at any time for examination.





At top: Stern-section of fuselage (C) showing bulkheads and method of framing. Below: Section (B) under construction. Note how section of fuselage is an integral part of wing stub engine mount undercarriage assembly.



Since the current program involves the construction of 60 airplanes of this type, of which the first eighteen are to be delivered by May 1, an extensive study of production and tooling methods had to be made before the first ship could be started. Both speed and accuracy were necessary to produce the required number of interchangeable parts on schedule and an elaborate series of jigs and fixtures were designed and built. Every unit, such as bulkheads, stringers, engine mounts, skin plating, window-frames, doors etc., was manufactured over accurate fixtures to very close tolerances. This method not only made for complete standardization but effected tremendous savings in manufacturing time and labor, and therefore great economies in the cost of production.

The entire plane, with the exception of a small amount of Haskelite used in the cabin insulation and in the flooring is of all-metal construction. The fuselage is a semi-monocoque type built entirely of duralumin, consisting principally of reinforced sheet metal bulkheads, longerons of a heavy channel section, skin stiffeners of smaller, lighter gage channels and a smooth skin—the whole assembled by rivets. The framing was built in three sections over wooden forms, (1) a nose-section (A—see three-view drawing) containing forward mail pit, radio compartment cockpit, and the forward portion of the cabin. (2) a center-section (B), a short section of the cabin built integral with the wing stub, and (3) the tail section (C) containing the balance of the cabin, the toilet and baggage compartments, and the structural supports for stabilizer and fin. A nose-piece (N) rounds off the forward-section, and a tail-piece (T) covers up the tail wheel mechanism and fairs the after-portion of the fuselage. The most complicated fuselage element is section B, for through it are transmitted all wing, power plant and landing loads. The engine mounts and the landing gear with its retracting mechanism are integral parts of this section, as indicated in the accompanying plan-view, It may be said that section B is the backbone of the entire ship,

The landing gear follows the same general principle laid down for the original Monomail (see "Retracting Landing Gears," Richard M. Mock, Aviation, February, 1933) with the wheels folding backward into recesses in the under-portion of the wing. About half the effective wheel diameter extends below the wing boundary when in the retracted position, so that it is possible to land without damage to the underbody of the airplane in the remote

event of failure to lower the gear An electrical mechanism, with auxiliary manual control, is provided for operating the landing gear Retraction requires 40 seconds, extension 30 seconds Large diameter, low-pressure Goodrich tires are used The wheels are equipped with Boeing oleo shock absorbers and hydraulic wheel brakes The full-swiveling tail wheel also carries a low-pressure tire and oleo shock absorber.

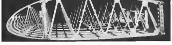
The wing is in five sections, the stub integral with the fuselage as described above, two outboard panels to which the ailerons are attached, and two removable wing tips. An all-metal tapered cantilever structure is used, with spar trusses of square and rectangular aluminum-alloy tubing, tubular ribs and a smooth aluminum alloy sheet covering The outboard panels are bolted to the stub beyond the nacelles Both the leading edges of the stub and the trailing edges of the main wing are, like the wing tips, removable to facilitate maintenance and inspection

The cantilever tail surfaces are of similar duralumin construction, and are covered with a smooth metal skin Both the elevators and the rudder are provided with adjustable trailing-edge flaps to provide longitudinal trim and to correct unbalanced propeller thrust when one engine is out of operation. The stabilizer is fixed to give correct balance at cruising speeds with full load.

As shown by the layout, two 550-hp supercharged Pratt & Whitney Wasp engines are mounted in nacelles well ahead of the leading edges of the wing stubs, a location conforming to latest N.A.C.A. recommendations for low drag and high propulsive efficiency Nacelles are beautifully faired into the wing section. Each engine swings a three-bladed Hamilton Standard propeller, and is fitted with a quick detachable ring cowl Exhausts are carried below the nacelles under the wing, and an interesting mounting has been worked out for the oil radiators on top of the nacelles They are covered with streamlined hoods through which cooling air is induced by the slip-stream action Two fuel tanks with a total capacity of 265 gal (sufficient for about four hours at cruising speed) are mounted in the wing stubs, one on each side of the fuselage.

The first of these new transports is already in service on United Air Lines' Pacific Coast route, and fourteen are to go in service about April 1, with additional deliveries at the rate of ten a month United Air Lines plans on radically reducing its San Francisco-Chicago-New York schedules in May, as sufficient of the new airplanes will be in service at that time to replace existing tri-motored equipment.

The general specifications and the performance figures furnished by the manufacturer for this airplane are span 74 ft., length overall 51 ft. 4 in., wing area (including ailerons) 836 sq.ft., stabilizer area 73.8 sq.ft., elevator area 58.9 sq.ft., fin area 17.6 sq.ft., height overall (including radio mast) 16 ft.; weight empty 8,385 lb rated pay-load 2,400 lb, top speed (at 5,000 ft.), 182 m.p.h.; cruising speed at 5,000 ft. (full load of ten passengers, crew of three and cargo), 165 m.p.h., landing speed, 58 m.p.h., rate of climb (at 5,000 ft.), 830 ft. per min., service ceiling, 18,400 ft. range (271 gal. fuel at 1,900 r.p.m.), 730 miles.


Wing construction of new Boeing transport

A German high-speed transport

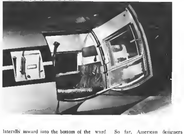
COMPARISONS are always interesting and may be extremely valuable. Elsewhere in this issue Mr Warner has discussed European operating and maintenance practices in contrast with those on U S airlines, and thanks to an interesting document compiled by Mr Kurt K Lammertz of Ernst Heinkel Flugzeugwerke of Warnemuende Germany, we are able to make some interesting comparisons between one of the latest foreign developments in high-speed transport practice, and our own The Heinkel He70 high-speed passenger and mail plane incorporates features which merit careful attention To American readers the general specifications sound very familiar,—single-engined, low-wing, full-cantilever monoplane with semi-monocoque all-metal fuselage, fitted with landing gear fully retracting into the lower surface of the wing Such a description fits half a dozen familiar types, but it is only when the details are examined that the essential differences become apparent

The first and most obvious variation lies in the selection of power-plant Except for Mr. Ford's attempt to develop a high-capacity cargo carrier, no American manufacturer, for many years, has produced a single-engined transport with liquid cooling In Europe, however, where the predominance of the radial air-cooled engine in commercial ships is not as great as it is in this country, Heinkel's use of the B.M.W.VI engine (630 hp at 1,600 r.p.m., direct drive, Glycol cooling) is not entirely unusual Although the specific weight of the power-plant is relatively high (a factor which reduces the payload-horsepower ratio of the airplane somewhat below the average values attained in similar American machines), its small frontal area makes for low parasite drag and permits a fairing around the nose of the fuselage reminiscent of Schneider Cup racers The Glycol radiator, which is mounted on the under part of the fuselage back of the engine, is very small and can be retracted in flight The streamlining effect is heightened by the mounting of an unusually large spinner.

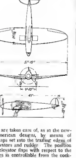
The engine cowling fairs smoothly into the fuselage, which is of oval section and of unusually high fineness as compared with American practice Structurally, it is composed of a series of transverse frames braced by longitudinals which run the entire length of the body The skin-plating is perfectly smooth and unbroken,—all rivets being counter-sunk. Window-glass panels are curved to conform to the shape of the fuselage, and are mounted flush with the skin Even the door handles have been counter sunk flush with the surface.

Except for certain flying boat or amphibion designs, where a continual exposure to corrosive atmosphere has dictated the use of wood for wings, no current American design exhibits the mixed construction used in the new Heinkel where an all-metal fuselage is used in conjunction with an all-wood wing The latter is built as a single unit and attached to the fuselage by inserting the spars into cut-outs, and fastening by means of bolts The wing is of an inverted gull type, of a modified elliptical plan-form, tapering in thickness It is built around two wooden box spars and a number of closely-spaced wooden ribs, planked with plywood. Due to the negative dihedral at the roots, the intersection with the fuselage is practically at right angles, eliminating, it is claimed, the necessity of excessively large fillets It would be interesting, however to see the effect on performance of the application of trailing-edge fillets of the type developed for the Northrop Gammas

The tail surfaces follow conventional patterns, and are similar to the main wing in construction and material. Neither fin nor stabilizer is adjustable, but both are attached rigidly to the fuselage Fore and aft trimming, as well as correction in yaw for propeller



Clean lines of the nose of the Heinkel He70. Note radiator mounting and arrangement of retracting gear fairings. Right: A glimpse of the main passenger compartment of the Heinkel.

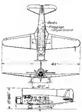


torque, are taken care of, as in the newest American designs, by means of small flaps set into the trailing edges of the elevators and rudder The position of the elevator flaps with respect to the elevators is controllable from the cockpit in flight, but adjustment to the flap on the rudder can be made on the ground only

Two general types of retracting landing gears have been adopted by designers in this country (see AVIATION February, 1933) In one system the wheels are swung upward and backward into recesses in the wing, or nacelles, as on the new Curtiss Condor, Martin bomber and Boeing transport. The other method—that employed on the Lockhred Orions and Stinson Juniors—involves the swinging of the wheels laterally inward into the bottom of the fuselage or into a wing stub The Heinkel, on the other hand in common with certain other European designs notably the Bleriot transport exhibited at the recent Paris Salon retracts the gear by swinging the wheels laterally outward away from the fuselage into pockets in the outboard panels of the wing When in the down position the wheels are supported on a simple tripod allowing for the normal type of shock absorber, and a simple brake system. A hydraulic cylinder acting through a cable and pulley raises the wheels, and the inboard bracing member of the tripod slides along a track and folds into a recess in the wing The wheels and the struts carry fairing covers so that when the gear is in the retracted position there is no break in the lower contour of the wing The details of the gear can be seen in one of the accompanying photographs The main wheels are 8x35 in, of the high-pressure type In accordance with German practice the tail is supported on a skid which is fitted with a broad-faced replaceable shoe and which retracts automatically with the main gear.

The machine is laid out to carry five passengers, a radio operator, and one pilot Again, the pilot's compartment differs radically from American practice No full-vision "cab" has been provided The pilot sits with his body entirely within the boundary of the fuselage with his head projecting through a relatively small cockpit-opening completely covered with a streamlined transparent enclosure faired into a long headrest As can be seen in the three view drawing the cockpit is not on the center line of the fuselage, but has been offset to the left to improve the pilot's vision forward and downward So far, American designers have been unable to tolerate any such departure from symmetry, but it is an idea that may be useful in some cases. The radio operator normally is responsible for the control of the retracting landing gear, but its mechanism is also within easy reach of the pilot Four of the passengers ride in a comfortable cabin amidship, two facing forward and two aft, on leather-upholstered cross-seats A fifth passenger can be accommodated on a folding seat in the pilot's compartment alongside the radio operator

Excellent performance has been reported for this airplane A top speed of about 226 m.p.h. has been measured officially by the German Government aeronautical laboratories An average speed of 208 m.p.h. was maintained over a 62½ mile triangular course with a payload of 1,100 lb. The general specifications as given by the manufacturer are: span 48 ft. 5 in.; length overall 37 ft. 8 in., height 10 ft 2 in.; wing area 393 sq.ft., weight empty 5,060 lb., useful load 2,222 lb., gross weight 7,282 lb.



All-metal high-speed transport designed by Gerard Vultee ready for test flight

Airplane Development's V-1 transport

GERARD VULTEE, for several years chief engineer of the old Lockheed Aircraft Company is responsible for the design of one of the latest American entrants into the high-speed transport class, a nine-place single-engined ship built by the Airplane Development Company of Glendale, Cal, recently organized subsidiary of the Cord Corporation Because of its origin, the new machine will probably be service-tested on American Airways upon completion of tests by the Aeronautics Branch of the U S Department of Commerce.

Externally, the ship is of the now familiar low-wing monoplane pattern a type which has become almost conventional for 1933 single-engined transports It is fitted with a Wright Cyclone Model F-2 engine, and provides seating accommodations for eight passengers and a pilot. It carries fully retracting landing gear, a feature which has become (with one notable exception) almost standard for this type

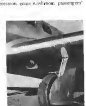
In structural detail Vultee's design exhibits a number of novel features. The fuselage, for example, a true monocoque type of modified elliptical cross-section, is made up entirely of narrow strips of flat Alclad sheets laid transversely over a series of U-section diaphragms Each panel overlaps shingle-fashion the one immediately behind it, and as individual panels are relatively short in proportion to the total length of the fuselage, it has been considered unnecessary to pre-form them This feature has an important bearing on maintenance, for if it is necessary to repair a damaged fuselage in the field, any panel may be removed by merely drilling out the rivets, flattened out, and used as a template for cutting and drilling a new piece. Replacement is thus possible from flat sheet stock by a metal-worker of reasonable skill without recourse to expensive jigs or fixtures to pre-form the sheet or to keep the fuselage in line.

Wings are all-dural of the so-called "shell" type, in which all bending and shear loads are taken by the covering The latter is of composite construction For the upper surface an inner corrugated member runs the full length of the wing, joining the main structural members at the leading and trailing edges, and a smooth Alclad outer covering is riveted over the corrugations The bottom covering is composed of flat sheets reinforced by U-section stringers The span is in three parts,—a center-section built integral with the fuselage, and two outboard panels attached to the stub by means of bolts. Removable sections in the bottom afford ready access to the interior for inspection and repair The ailerons are long and narrow and are statically balanced about their hinge axes

Tail surfaces are of the same general type as the wing Both fin and stabilizer are solidly built into the fuselage Longitudinal trim and slip-stream torque are taken care of by means of narrow trailing edge flaps on the rudder and on the elevators. The rudder flap can be adjusted on the ground only but the elevator flaps are under the control of the pilot In this respect the arrangement is similar to that used on the Heinkel He 70, also described in this issue.

The wheel supports of the retracting landing gear are built up from sheet duralumin as a simple box-type girder The lower end encloses an oleo shock absorber and the necessary brake operating mechanism, and the upper end is keyed to a longitudinal shaft which carries a section of worm wheel Raising and lowering the gear is simply a matter of rotating a worm engaged in the wheel, normally by means of an electric motor actuated by a switch in the cockpit, or, in emergencies, by hand-cranking With the electric drive the action of the gear is quite rapid. Lowering the wheels requires about seven seconds, and retraction but very little longer The wheels and supports carry fairing members which act automatically to cover the wheel well and make a smooth surface of the bottom of the wing when the gear is retracted Incidentally, rather ingenious use has been made of the wheel recesses in the bottom of the wing stub to house the landing lights. When the gear is retracted the lights are completely covered up, but are unobstructed when the wheels are down This arrangement can be seen in one of the accompanying photographs

Although the pilot's compartment in the nose of the ship appears wide enough to accommodate two men and dual control, only the left-hand seat and controls are installed—the right-hand side of the cab being occupied by a 20 cu ft. mail compartment Instruments have been grouped on separate panel units individually demountable. The usual wheel type of control is installed, but the under part of the wheel rim has been cut away, a feature found more frequently in European ships than in our own. A sound-proof bulkhead separates the cockpit from the passenger cabin The fuselage section through the cabin is 62 in high and 56 in wide, making ample room for eight comfortable chairs arranged four on each side of a 12-in aisle Aft of the cabin in succession come washroom passengers' baggage compartment (30 cu ft.), and radio equipment



Landing gear on Airplane Development Company Model V-1 Note construction of wheel supports, and the location of the landing light inside the wheel well

The ship has shown a top speed of 225 miles an hour and cruises at about 195 miles an hour The general specifications given by the manufacturer are as follows Span 48 ft 0 in , length overall 35 ft 6 in , height overall 9 ft. 3 in., wing area (including ailerons) 361 5 sq ft., ailerons 39 8 sq ft., stabilizer 38 6 sq ft., elevators 32 5 sq ft fin 9 9 sq ft , rudder 14 1 sq.ft.; weight empty 4,275 lb ; gross weight 7,250 lb

Goodyear develops new Airwheel brakes

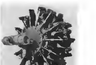
THE application of brakes to the low-pressure airplane wheel has been somewhat difficult, due primarily to the small size of the mounting hub Mechanically-operated band type brakes show relatively low efficiencies, and are subject to certain maintenance troubles caused principally by the fact that there is little provision for the dissipation of heat generated at the braking surfaces. One case which came under the personal observation of the writer indicates something of the troubles which arise from this source. A heavy cabin-type airplane was being used for practice take-offs and landings on a hot day at one of the large Texas airports. After half a dozen landings and some ground maneuvering (undoubtedly attended by excessive use of the brakes), the ship came to the line with one wheel actually on fire and the other too hot to touch Quick action on the part of the maintenance crew prevented damage to the airplane, but two inner tubes and one casing were a total loss This was a case of severe and unusual abuse, but it serves to illustrate what can happen to friction-generated heat penned up inside a tire which acts as a thermal insulator

To eliminate just such difficulties, Goodyear engineers have completely redesigned the hubs for Airwheels A hydraulically-operated disc type brake has resulted, which differs materially from anything that has so far appeared for this purpose Drawing heavily upon the lessons learned from years of development on metal automobile clutches, the designers have built the new device around a series of alternate steel and bronze discs, the former splined to the fixed axle, and the latter to the rotating hub, with the braking power applied by compressing the discs axially under hydraulic pressure Oil pressure is supplied from a master operating cylinder attached to the brake pedal, to an annular piston in the brake assembly which tends to press the rotating discs against the stationary discs to create controlled friction and the resulting braking action.

The new brake has almost five times the effective area of the older band type, and more important still, the frictional elements are practically external to the hub, which permits a high rate of heat dissipation and eliminates danger of burnouts The same factor makes also for ease of maintenance, as the entire brake assembly can be removed if necessary without disturbing the tire and hub The oil line pressure required for satisfactory operation is approximately 150 lb about one fourth that required for the operation of hydraulically-operated band type brakes The overall weight of the new system compares favorably with other mechanically-operated installations, and application can easily be made to any airplane to replace any previously installed system

Pratt & Whitney twin-row Wasp

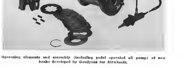
ACTIVE development of twin-row radial engines by Pratt & Whitney Aircraft Company dates from the early part of 1929, when an intensive study was made of various cylinder arrangements with an eye toward increasing the horsepower of power-plant units over and above that afforded by single-row radial engines In the late fall of that year construction was started on a two-row engine of approximately 2,300 cu in. displacement with two banks of seven cylinders each, fitted with a 2 1 propeller reduction gear Extensive block tests, followed up by flight testing in a Boeing 40B indicated that the design was practical, and the field work was supplemented by wind-tunnel testing on models to determine the relative drag of single and double-row arrangements The twin-row was found to have certain advantages beyond the reduction in drag per unit of power The use of a large number of cylinders of small diameter reduces reciprocating weights, making it possible to operate at higher crank speeds with improvement in general running smoothness Reduced power input per cylinder also makes for longer life Higher crank speeds made some form of reduction gearing necessary, and research led to a choice of gear ratios which make possible high efficiencies with propellers of reasonable diameter and weight Not only is propulsive efficiency improved but lower tip speeds mean distinctly quieter operation,—both factors in line with modern air transport requirements.



Pratt & Whitney's New Twin Wasp

By the end of 1930 it was decided that the 2,300-cu in engine was larger than any immediate usage indicated, so work was started on a 1,830-cu in model, and later on a 1,535-cu in engine. The smaller of these two models, the Twin Wasp Junior, was announced in the spring of 1932, and exhibited at the Detroit Aircraft Show It was described in some detail on page 241, AVIATION, May, 1932 Announcement has just been made of the availability of the larger model, the Twin Wasp The two engines carry A.T.C.s 95 and 96 respectively

With its displacement of 1,830 cu in the Twin Wasp is rated 830 hp at 2,400 r p m, an output which can be maintained up to 4,500 ft by supercharging Over a 100-hour test the average fuel consumption was 55 lb per hp-hr with oil at 027 lb per hp-hr With a dry weight of 1,125 lb the specific weight is 1 36 lb per hp The propeller reduction gear ratio is 3 2 The overall diameter is $47\frac{3}{8}$ in as against the $51\frac{7}{16}$ in diameter of the standard Wasp



Operating elements and assembly (including pedal operated oil pump) of new brake developed by Goodyear for Airwheels.

In detail the two new engines follow standard Pratt & Whitney construction practice Crankcases are of aluminum-alloy, cylinders of composite construction with forged steel barrels and screwed-on aluminum heads, forged aluminum pistons and forged steel crankshaft and connecting rods. Each engine can be broken down into three specific units,—first, the nose-piece containing the reduction gearing, propeller shaft bearings, front bank valve tappets, etc; second, a power-section made up of the two banks of seven cylinders each in a split case built around a well-supported two-throw crankshaft, each crank pin carrying a master rod and six link rods, and third the rear crankcase section which takes care of the rear bank valve tappets, built-in General Electric type supercharger, and the drive and supports for the engine auxiliaries One feature which is important from a maintenance standpoint is the fact that the three elements of the engine may be built up indpendently of each other, and then assembled.

Auxiliary equipment consists of Eclipse starter, Stromberg double-barrel carburetor, two fourteen-cylinder Scintilla magnetos, oil pumps, oil strainer, fuel pump, gun-synchronizer drives, as well as tachometer and generator drives Provision is also made for mounting and driving a vacuum pump for instrument drives and also a pressure unit for the operation of de-icing overshoes Connections are also provided for the installation of the special hydraulic valve for supplying oil to Hamilton Standard hydraulically-operated controllable pitch propellers

Comparative specifications of the two Pratt & Whitney fourteen-cylinder twin-row engines are as follows:

Twin Wasp Junior

Rated b.hp.	700 at 2,500 r.p.m. at 8,000 ft.
Weight (dry)	975 lb.
Diameter	43¼ in.
Fuel consumption (cruising speed)	0 46 lb./hp-hr
Oil consumption (cruising speed)	0.020 lb./hp.-hr
Propeller reduction gear ratio	4:3

Twin Wasp

Rated b.hp.	830 at 2,400 r.p.m. at 4,500 ft.
Weight (dry)	1,125 lb.
Diameter	47½ in.
Fuel consumption (cruising speed)	0 46 lb./hp hr
Oil consumption (cruising speed)	0 020 lb./hp.-hr
Propeller reduction gear ratio	3:2

formance testing employed by the average commercial airplane organization, weather conditions and other important variables may be neglected Changing of propeller setting, changing propellers, admitting more air to a starved carburetor, changing to high compression pistons or charging supercharger gears are tricks of the trade which may be employed by an enthusiast to prove his point where he is out from under the watchful eye of an Army or Navy trial board He is apt to minimize the importance of such changes even in his own mind and consider that they are not worth mentioning

The estimate of 60 lb for the difference in weight between a fixed and a retractable gear for a transport of 8-12 seats seems to be rather optimistic, but even 60 lb may eliminate one passenger where the weight allowance is on the ragged edge.

One feature of the retractable landing gear which has received very little attention is the effect which its drag has on stability and control In preparing to land, a pilot ordinarily needs all of his faculties to judge the approach and to handle the controls If the flying qualities of the airplane and the "feel" of the controls suddenly change when the landing gear is extended the result may be a bad landing or, worse, a stall while turning into the field.

Roy G Miller
Hartford, Conn

WHAT OUR READERS SAY

Retractable landing gears

MR MOCK is to be congratulated on his very interesting article on Retractable Landing Gears, which was published in the February issue of Aviation He has invited our attention to practically every phase of this question Some of his thoughts are, I am sure, new to many of us There are several points, however, on which he seems to be rather too optimistic as regards the virtues of landing gear retraction

It is stated that an airplane having a top speed of 175 m.p.h. with a faired gear of fixed design showed an improvement of 25 m.p.h. when fitted with a retractable gear. This amounts to an increase of 14 per cent in speed and corresponds to a reduction in drag of about 33 per cent. The drag of the landing gear, according to this, would be 50 per cent as much as the drag of the airplane with landing gear retracted

The frontal area of a faired landing gear usually amounts to less than 10 per cent of the total frontal area of the airplane, including landing gear, fuselage, pilot's compartment, wing, tail, etc It is hard to believe that 10 per cent of the frontal area would have half as much resistance as the other 90 per cent This would mean that the resistance coefficient for the landing gear was 4.4 times as high as the average for the balance of the airplane, as based on frontal area It is true that landing gear fairing cannot be complete or perfect, but neither can the shape of other parts be such as to produce a minimum drag for a given frontal area The fuselage, in order to offer sufficient length for tail surfaces must usually have a fineness ratio of at least 2.5 times the ideal fineness ratio Landing gear fairing suffers from no such limitation Furthermore, the fuselage lines must enclose the engine, cool it and dispose of the exhaust gases The pilot's enclosure and a number of minor items (such as door hinges, door handles, cowl fasteners and the like) add to the fuselage drag. The wings and the tail surfaces have about 2.5 times the fineness ratio of the ideal streamline strut section, and their shape is chosen for considerations other than minimum drag, as based on frontal area When we consider that an increase of 2.5 times the ideal fineness ratio corresponds to an increase of from 50 to 100 per cent in drag, it appears that the airplane we are discussing would have been about eight times as good a job of streamlining as its landing gear The resistance coefficient of a well-faired landing gear may be equal to the average for other parts of the airplane, but it certainly is not 4.4 times as great.

In the more or less haphazard per-

MR MILLER'S interesting comment is very much appreciated

In the general statement I made regarding the possible improvement in an airplane with an efficient retractable gear compared with a fixed external gear, I indicated the increase in speed rather than the reduction in total drag, because I felt that a definite figure for gain in speed was more comprehensible than an abstract drag figure I made the assumption that faster airplanes would have somewhat less drag and not achieve the improved speed through excess of power alone Therefore, I assumed that, because of the fixed size of struts wheels, and tires with materials and loadings now used, as the general cleanness of the airplane was improved, it was not possible to reduce the drag of the landing gear in direct proportion and that the ratio of landing gear drag to total drag would increase This has been observed on a number of actual designs which were tested with streamlined fixed gears as well as retractable gears As I mentioned in the article, the possible gain depends much upon the ingenuity of the designer and the purpose, type and size of the airplane

In the general statement, I mentioned that for a conventional airplane with 165-170 m.p.h. with a fixed external undercarriage a gain of 10 per cent was possible, corresponding to a reduction

in drag of about 24 per cent, allowing 1 per cent for improved propeller efficiency due to change in V/ND

The airplane which I used as an example, as having its speed actually increased 14 per cent by fully retracting the landing gear, was the low-wing Lockheed Sirius This model with external fixed gear had an exceptionally clean fuselage with filleted cantilever wing and tail Recent tests show that the cockpit opening did not greatly affect the drag However, the landing gear drag was far from being consistent with the low drag of the rest of the airplane The wheel was braced to the wing by a vertical shock strut and a "Vee" of two struts on the inboard side, one to the front spar and the other to the rear spar The space between the front and rear members of the Vee was completely filled by a flat surface meeting the wing at a fairly acute angle I believe that this surface and the interference between the surface and the wing accounted for a large part of the drag The intersection between the shock strut and the wheel fairing might have been improved slightly, while the wheel fairing in top view was considerably longer than the most efficient shape In addition, the opening in the bottom and the projecting tire also contributed to the drag

In the caption of the picture illustrating the Lockheed gear I mentioned a flap that was added to the later models completely covering the wheel when retracted Because of the higher speed this made a difference of 6 m.p.h., according to Mr Lloyd Stearman, president of the Lockheed Aircraft Corporation This 6 m.p.h. corresponds to a reduction in drag of 8 per cent neglecting any change in propeller efficiency, which would give some 18 per cent rather than 14 per cent

I believe the figures for the increase in speed on this plane to be accurate, because a number of planes of this type, both with retractable and fixed gears, were built and all seemed to indicate about the same increase in speed

Substantiating the above, Mr George W DeBell of the General Aviation Manufacturing Corporation states that their Clark GA43 low-wing transport, increased its speed over 15 per cent by retracting the landing gear The plane was tested, both with a single strut cantilever gear with struts and wheel streamlined, and with the retractable gear now used As both the speed of this plane and the Lockheed referred to are believed to be in the same range these values of 14 per cent and 15 per cent seem to be in agreement

Mr T P Wright, vice-president of the Curtiss Aeroplane & Motor Company, states that in checking over results obtained with several of their models in which retractable landing gears have been installed and on which other data pertaining to non-retractable landing gear is available he finds that the speed increase over the tripod type fixed gear is 10 per cent He draws attention to the fact that it is incorrect to compare these speeds with such gear retracted and extended, as in the extended position they have more drag than a fixed external gear initially designed for the plane His estimate of 10 per cent is on the basis of the true comparison, though he does not mention at what speed this is attained

From the figures I gave in my article, I believe it is clear that if 10 per cent, or even somewhat less were gained, it is advantageous to retract the gear

Regarding the weight of 60 lb for the addition of a retractable gear to an 8,000 lb transport, I draw attention to the fact that the complete retraction mechanism on the new Martin bomber weighs only 79 lb and this is a much larger airplane Mr DeBell states that the increase in weight of their plane, which is about this size, was 100 to 110 lb, considering each gear complete. He says this is relatively high, as the majority of the parts are not affected by the weight of the plane, such as the pump, and the valve mechanism, the oil lines, and the cowling to cover the landing gear after retraction In this plane, this portion of the weight, unaffected by the size of the plane, is 38 lb I believe that a hydraulic system is inherently heavy

Mr Wright agrees that if compared with a tripod gear this weight of 60 lb appears to be correct. He mentions that on several of their recent planes they have used a single strut cantilever gear which is considerably heavier than the tripod type. With this type of gear he states that their experience is that the speed would only be increased 5 m.p.h. when going to the fully retractable gear, but that the weight would actually be lessened by some 50 or 60 lb

In considering the additional weight of the retractable landing gear, one should not neglect the saving in fuel due to the improved speed and the weight of the streamlining on the fixed external gear On the Lockheed Sirius the weight of the wheel fairing is 50 lb

Regarding the fourth paragraph of Mr Miller's letter I can only say that I attempted to be conservative in any of the general statements I made and that most were based upon data known to be accurate I doubt if the gains indicated to me by some of the commercial manufacturers were obtained by supercharging or the use of higher compression ratios However, I call attention to the fact that the higher speeds, due to the retractable gear, may slightly increase the dynamic pressure on the carburetor intake, slightly supercharging the engine and increasing its power This I believe is another point supporting the retractable gear, as is the fact that at the higher speeds the opening for taking in air to cool the engine can be reduced, reducing the drag

I do not believe that very many detailed data exist on the effect of the drag of the landing gear, when down, on the stability or flying characteristics of the airplane.

Richard M Mock

NEW VOLUMES FOR THE SHELVES

Vocational Training for Aviation Mechanics *Bulletin No 142, Trade and Industrial Series No 40, Federal Board for Vocational Education, United States Government Printing Office, 286 pages, 35 cents* A comprehensive survey of the work of the aviation mechanic and his relationship to commercial aviation The data in this book were compiled by personal investigation by representatives of the Federal Board for Vocational Education in practically every airline maintenance shop and mechanics school in the country Copiously illustrated with photographs and charts, it gives a clear picture of the training the requirements and the opportunities in aircraft mechanical work Well worth the nominal fee for anyone who has any interest in commercial aviation, from mechanic to chief executive.

Flying Over South America, *by Annie S. Peck, Houghton Mifflin Company Boston, Mass 1932 256 pages $3.50* The personal travelogue of an indomitable woman At the age of 79 Miss Peck set out, with the aid of Pan American Airways and other South American air lines to revisit the scene of her sensational mountaineering exploits of 30 years and more ago She flew 20,000 miles and she tells the story in a very pleasant style. It is more interesting as a travel tale than in any directly aeronautical fashion, but it gives a very good picture of how air transport in South America is actually operating as the traveler sees it

SERVICING SHORT CUTS

Condor incorporates servicing short-cuts

IN DESCRIBING the new Curtiss-Wright Condor transport (page 58, AVIATION, February, 1933) mention is made of certain servicing features which were incorporated in the design as a result of experience gained from two years operation of older models on Eastern Air Transport. A few of the more striking are covered below, others will appear from time to time in these pages.

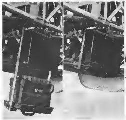
The mounting of storage batteries, always a troublesome problem, has been solved in an ingenious manner in the Condor. Each of the two nacelles carries a special container for a standard 12-volt, 65 amp hr. Exide battery in the underpart, accessible through a door in the bottom of the cowling. As shown in the accompanying photograph, the battery rests on a sliding platform which is in reality the bottom of the battery container. Raising the platform upwards not only inserts the battery in the container, but automatically establishes the electrical contacts. The battery terminals are conical in shape and engage in registering receptacles built into the top of the box. A 40-lb pressure is maintained at the contact surface, sufficient for a low resistance connection without necessitating the use of bolts, nuts, or flexible cable. One of the most important features of this arrangement is the fact that the battery is easily reached from the ground, and need not be balanced on stepladders or carried through passenger compartments. It is said that but 45 seconds are required to make a complete battery change.

The problem of inspecting the interior of large wings has been met in the Condor by the installation of an unusually large number of zipper fasteners. A photograph shows to what extent the wings can be opened up by this means. Tail surfaces and certain parts of the fuselage are similarly treated. Altogether 125 Monopul fasteners have been installed.

Extreme simplicity has been sought in the installation of engines and accessories. A clear compartment behind each mount 33 in. in length reached by removal of portions of the nacelle cowling makes for easy inspection and maintenance of engine auxiliaries. It is possible for a mechanic, working in this compartment, to remove any unit without detaching or disturbing other accessories or fittings. All controls, piping, etc., are concentrated at the center of the space, leaving plenty of room around the edges in which to work. Pipe lines are marked with identifying bands so that they may be traced easily, and all electrical wiring passes through shielded metal conduit. Twenty junction boxes are provided for quick maintenance and inspection.

Trouble is sometimes encountered in older designs from lack of clearly marked points on which the weight of the machine may be carried on jacks. On the Condor, eight jack pads have been provided: one on each side of the fuselage below the mail compartment, one under each axle, one under the tail assembly, and one on the fuselage near the tail. Two others are mounted on the underpart of the engine nacelles. The lifting point on each axle is arranged so that a landing wheel may be lifted free of the ground for tire replacement or brake adjustment without difficulty, even if the tire is flat to begin with. Landing gear and tail wheel assemblies are provided with numerous Zerk fittings for quick lubrication.

The instrument board, sectionalized as to function in accord with latest E. A. T. practice, has been rubber mounted to eliminate harmful vibrational effects. Each section may be removed for maintenance without disturbing adjacent units. The radio equipment, mounted in the cockpit behind the pilots' seats, is also quickly removable as a unit. It is claimed that it can be replaced in two minutes, thus making a complete change possible during refueling, or while loading passengers.



Left: Storage battery installation on underpart of engine nacelle on the new Curtiss Condor. The battery can be conveniently reached by a man standing on the ground. Note the latching device. Above: A few of the inspection openings along the wings of the new Curtiss Condor.

"SWISSAIR" SAYS . . .

"We are highly satisfied with the experience of your B. G. Spark Plugs."

Map of "Swissair" Routes

"Swissair" Lockheed Orion over Zurich Switzerland.

"Swissair" three-engined Fokker flying around the famous Matterhorn. The Matterhorn, one of the Swiss Alps, is 14,861 feet high

Photos by Ad Astra-Aero Photo A. G. Zurich

B. G. Mica Aviation Spark Plugs are patented in the United States and other countries.

In 1932 "Swissair" made 3,850 transportation flights and carried 14,382 passengers.

THE B. G. CORPORATION

Contractors to the United States Army and Navy and Aircraft Engine Builders

136 West 52nd Street, New York — Cable Address: Golsteco, New York

HERE'S THE NEW WACO MODEL "A" FOR 1933

. . . AND IS IT A HONEY!

At first we didn't see how we could greatly improve the 1932 Model "A" WACO. But you can always find a way to do a thing if you try hard enough. So we went to work and the first thing you know we had figured out no less than *twelve major improvements!* Not "gadgets," mind you, but important new developments—every one worth talking about.

It would take too long to go into detail here, but we'll be glad to send full particulars to anyone who's interested, because we're enthusiastic about what we've accomplished and want the world to know about it.

Briefly, we've got a ship that any man can be proud to own and happy to fly. The seats are side by side. That's for sociability. There's room for luggage—golf clubs—guns—fishing tackle—whatever you want to carry—100 pounds or more of it. That's so you can start on a sizeable trip without worrying about who's going to take care of your laundry en route.

And here's something else. You can make an open or a closed cab of this ship simply by pushing the top forward or backward!

As in all WACOs, this model takes off or lands on a dime. It's a brilliant performer that almost handles itself. It's safe—sturdy—beautiful to look at.

This sounds like almost too much to expect in one ship. That's why we always urge prospective buyers to *fly* it. It proves its right to lead the parade better than anything we know of.

P. S. We've got such an unusual proposition for dealers that we're anxious to get in touch with a few more. There's a real proposition in connection with the WACO franchise for 1933

HERE ARE THE 12 MAJOR IMPROVEMENTS THAT WILL KEEP WACO OUT IN FRONT AND UP ABOVE AGAIN IN 1933

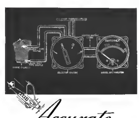
1. *Better streamline—including landing gear* **2.** *Rounded fuselage* **3.** *Improved top. No doors, tracks, leaks. Opened or closed by sliding backward or forward* **4.** *Wider cockpit for greater comfort* **5.** *Deeper, more luxurious upholstery* **6.** *Center throttle easily accessible to both pilots* **7.** *Dual control installed either in the air or on the ground* **8.** *Central emergency brake* **9.** *Greater visibility* **10.** *Greater speed* **11.** *Fully equipped, including air speed indicator* **12.** *More beauty in design and finish*

THE COST? MUCH LESS THAN YOU'D EXPECT

With Jacobs 170 H P engine only	$4,265.00
With Continental 210 H P engine, only	4,395.00
Winter enclosure	195.00

THE WACO AIRCRAFT COMPANY, TROY, OHIO

WACO AIRPLANES
"ASK ANY PILOT"
WACO LEADS IN AIRCRAFT REGISTRATION



Accurate

ENGINE TEMPERATURES

at a glance! ELECTRICALLY

No referring to a cockpit thermometer. No calculating of any kind. Just a glance at the Weston Indicator and the pilot knows instantly the exact engine temperature. With the aid of the proper position selector switch, the temperatures at 2, 3, 4 or 9 different desired points are immediately indicated

Tubing, liquids, and the consequent leakage and maintenance are eliminated. Weston supplants them with trouble-free Thermocouples and an electrical indicator. Installations are quickly and easily made.

Complete data are freely offered. Weston Electrical Instrument Corporation, 616 Frelinghuysen Avenue, Newark, New Jersey.

WESTON *Instruments*

Ammeters • Voltmeters • Oil Temperature Indicators • Engine Temperature Indicators • Air Temperature Indicators • Electric Tachometers

HASKELITE in the new BOEING 247's

Boeing has used Haskelite plywood exclusivley for fourteen years! Need any more be said?

HASKELITE MANUFACTURING CORPORATION
120 South La Salle Street
Chicago, Illinois

Member Aeronautical Chamber of Commerce

Manufacturer of Progressive Aircraft Finishes

PAINT UP

FOR 1933

Now is the time to refinish or tone up your plane with Berryloid Aircraft Finishes made just for that purpose.

Berry Brothers also manufacture a full line of Airport maintenance paints in popular shades.

Remember—Save the Surface and You Save All.

BERRY BROTHERS

PAINTS · VARNISHES · ENAMELS · LACQUERS
DETROIT, MICHIGAN WALKERVILLE, ONTARIO

Machinery Material Parts and Accessories for Airplane Manufacture Maintenance and Operation

AVIATION

Equipment Accessories and Supplies for Airport Construction Operation and Maintenance

SERVICE SECTION

TO THE END

that readers may be made acquainted with a larger number and variety of individuals and concerns offering time or cost saving products or services to the industry covered by this paper, the "Aviation Service Section" appears as a supplement to other advertising throughout the paper. You are urged to give these announcements careful attention each issue

STANDARD AIRCRAFT FINISHES
Since 1913
TITANINE
TITANINE INC. UNION, N. J.

IMPROVED DOPES
PHENIX CLEAR NITRATE DOPES
Clear — $1.05 per gal. in 50 gal. Drum included
— $1.10 per gal. in 30 gal. Drum included
— $1.20 per gal. in 5 gal. boxed cans
Pigmented — $1.90 per gal. in 5 gal. boxed cans
Yellow, Blue, Red, Green, Cream, Khaki, Aluminum, Black, White. Immediate shipments, fresh, high grade.
PHENIX AIRCRAFT PRODUCTS CO.
Willamsville, N. Y.

AIRPORTS AND FLYING SCHOOLS
"THE ACROPLANE"
Develops Students & Flight Customers
"THE ACNOPLANE"
Instructive—Teaches Stick Control"
"THE ACNOPLANE"
The Magic Ride"
"Draws the Crowd Like a Magnet"
"THE ACNOPLANE"
DISTRIBUTORS
For Descriptive Literature, etc. Write to
R. F. RICE, INC.
Ralston F. Rice, President
Sales Office, Hotel Dixie
Executive Offices
620 E. 119th St. N.Y.C.
Tel. Mott Haven 9 4188
West 43rd Street
New York City
Tel. Wisconsin 7-6000

PROFESSIONAL SERVICES

SCHOOLS

Patent Your Ideas
Call or send me a sketch of your invention Phone LOngacre 5-3088
FREE Inventor's Recording Blanks Confidential Advice
U. S. and Foreign Patents secured by
Z. H. POLACHEK Reg. Pat. Attorney Consult. Engineer
1234 BROADWAY, N. Y., at 31st St.

PATENTS — TRADE MARKS
All cases submitted given personal attention by members of the firm. Information and booklet free.
Patent Office and Federal Court Practice
Lancaster, Allwine & Rommel
Patent Law Offices
Suite 431, 815 15th St. N.W., Washington, D. C.

DANIEL GUGGENHEIM SCHOOL OF AERONAUTICS
Graduate and Undergraduate Courses in Aeronautical Engineering and Air Transport. Particulars from Dean, College of Engineering.
NEW YORK UNIVERSITY
University Heights, New York, N. Y.

A Personal Want—

can invariably be filled by a friend.

The Searchlight Section

of this issue covers the current business wants of the industries in which this paper is read.

For Every Business Want
"Think SEARCHLIGHT *First"*

A Business Want—

must be satisfied by someone in your industry.

0184

EDO FLOATS

SEAPLANE OPERATORS MAKE THE FLYING BUSINESS PAY

Seaplanes are cheaper to buy and fly—faster—safer—more easily handled. In regular service between the waterfronts of major cities, in commuting service to lake and sea resorts, in charter trips or in short pleasure flights at recreation centers, EDO-equipped seaplanes win patronage and profits. There is a standard EDO Float Installation for your ship. Write for details and new low prices. EDO AIRCRAFT CORP., 610 Second St., College Point, L. I., N. Y.

May Issue Closes April 18th

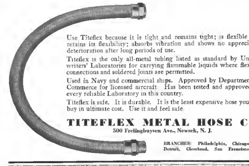
Early receipt of copy and plates will enable us to serve you best—to furnish proofs in ample time so changes or corrections may be made if desired.

AVIATION

Additional
For Sale, Equipment Wanted
and
Positions Wanted Ads, etc.

Continued on the following page

USE TITEFLEX *All Metal* FLEXIBLE HOSE FOR OIL AND GAS LINES . . . .



Use Titeflex because it is tight and remains tight; is flexible and retains its flexibility; absorbs vibration and shows no appreciable deterioration after long periods of use.

Titeflex is the only all-metal tubing listed as standard by Underwriters' Laboratories for carrying flammable liquids where flexible connections and soldered joints are permitted.

Used in Navy and commercial ships. Approved by Department of Commerce for licensed aircraft. Has been tested and approved by every reliable Laboratory in this country.

Titeflex is safe. It is durable. It is the least expensive hose you can buy in ultimate cost. Use it and feel safe.

TITEFLEX METAL HOSE CO.

500 Frelinghuysen Ave., Newark, N. J.

BRANCHES: Philadelphia, Chicago Detroit, Cleveland, San Francisco

SEARCHLIGHT SECTION

(Continued from preceding page)

POSITIONS WANTED

AERONAUTICAL engineer, experienced in airplane design, with specialization in seaplane and flying boat design, desires connection with firm engaged in aeroplane and flying boat development. Any location. PW 212 Aviation, 330 West 42d St., New York City.

SITUATION wanted—By ex-Army Officer, age 38. University graduate. Eleven years' advertising and publicity experience. Seven additional years in U. S. Army air corps and Aeronautics Branch of U. S. Dept. of Commerce. Initial salary and location no object. Robert Clary, 218 S. Eugene, Greensboro, N. C.

TRANSPORT pilot, 28, married. One thousand hours Navy time. Radio telephone license, wishes any connection with aviation. PW 211, Aviation, 520 No. Michigan Ave., Chicago, Ill.

FOR SALE

BELLANCA Pacemaker Wasp Jr. excellent condition, 1 year old, special leather upholstery, couch chair, semi air wheels, pants, ring cowl, paint like new. Bellanca Aircraft Corporation, New Castle, Delaware.

BELLANCA Skyrocket, 36x8 tires, special upholstery, couch chair, ring cowl, paint excellent, ship fine condition, engine overhaul, included total time 523 hours. Bellanca Aircraft Corporation, New Castle, Delaware.

FOR SALE: J5 Stinson, six place, wonderful condition, very little time. Many extras. $1,150. J. W. Barton, Municipal Airport, Cleveland, Ohio.

LYCOMING Stinson for sale. T. F. Johnson, P. O. Box 358, Atlanta, Ga.

RYAN B5 6-place Brougham J 6 9 motor, dual control, fully equipped, privately used, only 90 hours flying time on motor and ship, purchased new last year. Cost $14,000, sacrifice for cash $2,250. H. L. Culver, 3436 Devonshire, Detroit, Mich.

FOR SALE

FOR SALE: New Floats suitable 4,000 to 5,000 gross load at attractive price. Bellanca Aircraft Corporation, New Castle, Delaware.

RYAN J5 $1,500. First-class condition. Recent complete overhaul including engine overhaul. Federal license. A real bargain. Joseph E. Kerigan, 1200 Main Street, Springfield, Mass.

SIKORSKY S 38 Twin Motor, 8 place flying boat. Completely rebuilt and relicensed $3,500. Also 2 Edo Deluxe Floats, will fit Robin or First, $150. William Link, 30-82 43rd St., Long Island City, N. Y.

AN INNOVATION

Save Money

REBUILD OR OVERHAUL YOUR OWN AIRPLANE OR MOTOR

Do It Yourself

FREE USE of shop facilities. Department of Commerce Approved Repair Station, licensed supervisors and completely stocked parts department at your service. Department Inspector always at hand at the busiest airport in the world.

Let us inspect your ship for relicense. Visiting ships appreciate our service.

MArket 3 2346 Mitchell 2-9105

EASTERN AERONAUTICAL CORP.
SKYPRODUCTS CO.

Newark Airport Newark, N. J.

WANTED

CURTISS D 12 V-450 engines. Any condition. Also parts. Tone Seal Co., St. Clair, Mich.

WANTED float and fittings for Waco J5 straight wing. Must be cheap. Texas Airplane Corp., Corpus Christi, Texas.

CATALOGUES

DON'T BUY anything until you get Ort's 1933 Aviation Material Catalogue. Prices are lower. Send one thin dime today. Karl Ort, 672 W. Poplar St., York, Pa.

BLIND FLIGHT

In Theory and Practice

By Maj. Wm. C. Ocker & Lt. Carl J. Crane

Only work covering subject. 210 pages, cloth bound. 114 illustrations. $3.85—5 day Money back guarantee. Order from dealer or write

Naylor Printing Co.

918 N. St. Marys St., San Antonio, Tex.

AVIATION!!

WOULD BE AVIATORS wishing to work on apprenticeship at airports for a shorter license should write for information on Air Mail Lines and Airports where apprenticeship connections are established.

Enclose stamped envelope.

Mechanics Universal Aviation Service
Hotel Detroiter, Detroit, Michigan

THE U. S. AIR CORPS takes in 450 men this year for FREE FLYING TRAINING. Given 200 SOLO HRS. Free. Uniforms. Transportation to Field. LIVING EXPENSES paid $75 a mo. while Learning to Fly. Real Flying Here. Training costs absolutely Nothing. Let us tell you How to Get In. Information about Uniforms, Rank, Leave and Actual Life at the New $12,000,000 Field. Your name brings the Information; give your name $1 and postage on arrival. It is complete. Nothing else to buy.

FLYING INTELLIGENCE BUREAU

431 Judson N. Bldg. Bldg., Los Angeles, Calif.

SAFE TO FLY EASY TO LAND

●So easy and safe is the Hammond* Airplane to fly, that the ship will actually fly itself under normal conditions. A published article states: "The basic flying characteristics of this airplane is its ability to balance itself if merely allowed to do so." In the Hammond Airplane we are offering the pilot unprecedented and unqualified *flying safety*.

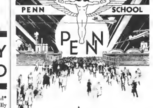
● The Hammond Airplane lands at 36 miles per hour. A wheel spread of 100 inches, large oleo type shock struts, semi-air wheels and brakes increase the *landing safety* to an unusual degree and cushion the shock of landing.

● Low cost means more than low *first* cost with the Hammond Airplane. Particular pains have been taken to minimize maintenance. Cruising at 90 miles per hour, the smooth, husky, five-cylinder Kinner Engine consumes only 6½ gallons of gas per hour.

*A full sized 3 place, quality biplane for the owner, student instruction, taxi work, etc. Flyaway equipment includes complete set of instruments, navigation lights and capacious baggage compartment.

$2,795 Fully Equipped

HAMMOND AIRCRAFT CORPORATION
ANN ARBOR, MICH.



AN AVIATION CAREER

Now Within Your Reach

... at an aviation school nationally famous for the thoroughness of its training, backed by four years of experience as a fully approved Transport, Flying and Ground School. Penn School of Aviation now offers you its many advantages at a cost no higher than the most ordinary type of aviation training.

In the history of Penn School, out of several hundred students, not a single graduate has failed to pass the U. S. Department of Commerce flying tests. Penn training equipment represents an investment of over a hundred thousand dollars and is the most up-to-date available.

Operated by Pittsburgh Aviation Industries Corporation and affiliated with Pennsylvania Airlines, it is in a unique position for understanding the needs of the entire aviation industry. As the industry has learned to expect nothing but the best from Penn School, only students of the highest character and personal qualifications are accepted.

ONLY COSTS HAVE BEEN CUT

The Nation's Highest Training Standards Still Prevail

REDUCTIONS

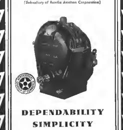
Private Pilot's Course—Reduced more than 46 per cent.
Limited Commercial Pilot's Course—Reduced more than 40 per cent.
Transport Pilot's Course—Reduced more than 40 per cent.
Master Pilot's Course—Reduced more than 30 per cent.
Hourly Training Rates for Sport Flyers Also Have Been Greatly Reduced.

For complete Details Address

PENN SCHOOL OF AVIATION

721 OLIVER BLDG., PITTSBURGH, PA.

Flying Schools — Pittsburgh Butler Airport — Bettis Airport — Harrisburg Airport



INDEX TO ADVERTISERS

Name	Page
B. G. Corp., The	8B
Bendix Brake Co.	Back Cover
Berry Bros	16
Boeing Airplane Co	15
Curtiss-Wright Airplane Co.	5
Cyclone Fence Co	18
Eclipse Aviation Corp	Third Cover
Edo Aircraft Corp	17
Ethyl Gasoline Corp	13
Fafnir Bearings Co., The	24
Giro Transport & Sales Co., Inc.	23
Hamilton Standard Propeller Company	10
Hammond Aircraft Corp	21
Haskelite Mfg Corp	16
Irving Air Chute Co	23
Kendall Refining Co	7
McGraw-Hill Book Co	12-14
Martin Co., The Glenn L.	6
Penna School of Aviation	21
Pioneer Instrument Co., Inc	Second Cover
Pitcairn Autogiro Co.	11
Pratt & Whitney Aircraft Co	Front Cover
Scintilla Magneto Co., Inc	22
Searchlight	17-19-20
Stanavo Specifications Board, Inc.	4
Stearman Aircraft Co	18
Stinson Aircraft Corp	12
Summerill Tubing Co.	14
Texas Co., The	8
Titeflex Metal Hose Co	20
Waco Aircraft Co., The	9
Weston Electrical Instrument Corp.	16
Wright Aeronautical Corp	8A

+

SEARCHLIGHT
Classified Advertising

BOOKS	19
BUSINESS OPPORTUNITIES	19
FOR SALE ADS	19-20
MISCELLANEOUS	19
POSITIONS VACANT	19
POSITIONS WANTED	19
USED AND SURPLUS EQUIPMENT	19-20

+

AIRCRAFT SERVICE DIRECTORY

Phoenix Aircraft Products Co	17
Rice, Inc., R. F.	17
Titanine, Inc	17

+

PROFESSIONAL SERVICES

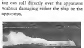
Lancaster, Allwine & Rommel	17
Polachek Z. H.	17

+

WHERE TO FLY	17

+

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Aviation* assumes no responsibility for errors or omissions.



Here's the *Vital* Spot

The Bearing—it *must* be trustworthy—able to stand up—take thrust as well as radial loads—be free of lubrication trouble both winter and summer—in fair weather and foul.

Fafnir Aircraft Ball Bearings enable Control Pulleys to meet these rigid requirements perfectly. The deep raceways will take a heavy thrust. The space between the seals affords a lubricant capacity much greater than is possible with other types of anti-friction bearings.

Fafnir Aircraft Ball Bearings are not merely conventional bearings forcibly adapted to aviation needs. They are *specially designed throughout*—the result of the closest sort of cooperation with plane manufacturers, pulley manufacturers and both the Army and Navy air forces. Fafnir Aircraft Pulleys are approved and accepted throughout the industry.

Fafnir-equipped control pulleys, as built by Formica and Westinghouse, assure reliability at that vital spot—the Bearing. Specify on your orders—"equipped with Fafnir Ball Bearings."

THE FAFNIR BEARING COMPANY, NEW BRITAIN, CONN.

Atlanta Chicago Cleveland Dallas Detroit Los Angeles
Milwaukee New York Philadelphia

Safeguarding Quality

Fafnir·Ball·Bearings

Vast Resources—High Craftsmanship—Far-sighted Vision—BENDIX

Nobody deliberately and knowingly buys inferior equipment for aircraft, where quality and fine performance are so necessary—yet there's no argument that certain products are better than others.

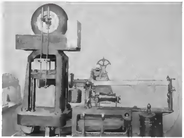
In the face of unrelenting pressure to reduce quality, Bendix believes that Aviation is best served by building every product as nearly perfect as possible; aiming at superlative performance.

Bendix Wheels and Brakes for airplanes and the new Bendix Pneudraulic Shock Strut are examples of how vast resources, high spirit of craftsmanship, and far-sighted vision may all be inspired by a single idea—a determination to produce "the best."

And typically Bendix is the development of special and exclusive machinery used in their manufacture; contributing to superior quality and lower costs.

The services of Bendix' corps of competent engineers are always available for consultation.

The pioneer product of their kind, and standing today as always for preeminence in quality, Bendix roller bearing Wheels are the standard type for military and civilian planes. Permanently improved braking, exact concentricity of brake and drum, reduced take-off run, ease of taxi-ing and improved ground handling are obvious advantages.



Radial Load Test—Bendix wheels of new design are subjected to static radial load test as shown above. The tire rests on soft earth to simulate ground conditions. The maximum radial wheel load applied during this test is approximately ten times the normal static weight which the wheel will have to support in service.

As the load is increased and the tire deflects and settles in the earth, the operator carefully watches the wheel for any signs of failure. An indicator is so placed in the wheel that it measures the slightest distortion of the brake drum with respect to the axle. Only a very small amount of distortion is allowed because, for maximum brake efficiency in service, the drum must run true with the axle while operating under severest landing and taxi-ing load conditions.

This illustrates the care with which every detail is checked so as to insure the very highest possible degree of safety to those who fly in airplanes equipped with Bendix Wheels and Brakes.

Another Bendix contribution to comfort and safety—the Bendix Pneudraulic Shock Strut. Impact loads absorbed by oil flow and air compression above the oil; taxi-ing loads by air compression. Rebounds definitely controlled by snubber.

BENDIX BRAKE COMPANY · South Bend, Indiana
(SUBSIDIARY OF BENDIX AVIATION CORPORATION)

Hand Inertia Starters • Electric Inertia Starters • Direct Cranking Electric Starters • Hand Turning Gears • Air Injection Starters • Battery Charging Generators (voltage regulated) • Double Voltage Radio Generators (voltage regulated) • Radio Dynamotors • Engine Driven Radio Dynamotors (voltage regulated) • Engine Driven Alternators (constant speed) • Engine Driven Vacuum Pumps (for navigating instruments) • Automatic Supercharger Regulators • Battery Booster Coils • Booster Magnetos • Fuel Flowmeters • Superchargers • Automatic Pitch Propeller Hubs • Ice Overshoe Air Pumps • Flexible Metallic Tubing.

Detailed data gladly supplied upon request

ECLIPSE AVIATION CORPORATION

EAST ORANGE
NEW JERSEY

Subsidiary of Bendix
Aviation Corporation